The FOUNDRY

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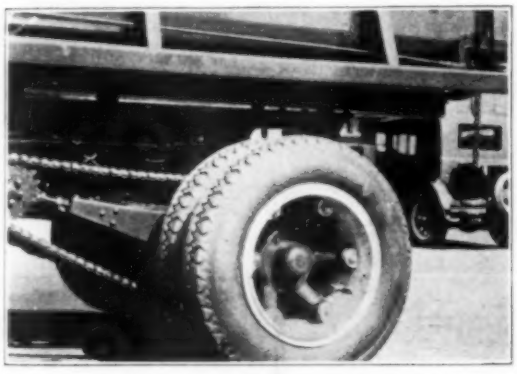
Castings Carry Freight Over Nation's Highways

STURDY trucks, co-operating with the railroads, have a share in transporting a part of the great tonnage of freight which constantly is in transit throughout the country. The severe demands imposed upon the wheels of the modern heavy duty truck has led to the adoption in many cases of steel or malleable castings for wheel construction. The early truck, as in the case of the passenger car, borrowed many ideas from the horse drawn



Increased Truck Capacities Has Resulted in the Use of Cast Wheels

wagon, and heavy wooden spokes were used in the wheel construction. As truck capacities increased, it was found advisable to substitute some stronger material for the spokes, and many manufacturers turned to castings as the best solution of the problem. The illustration shows a typical double tire wheel built up on a strong casting. The use of cast wheels has increased greatly since the introduction of that equipment. Various types of wheels have been developed to meet the needs of practically all types of trucks. Considering the fact that 530,890 trucks were produced in the United States in 1928, it may be seen that an extensive market is open for cast wheels. In addition, many buses now are equipped with cast wheels and many more probably could use that type of equipment with complete satisfaction.

Find Where Castings May Be Sold.

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Equipment

By Pat Dwyer

Fig. 1—(Top)—Each machine is served by an individual sand hopper. Fig. 2 (Left)—General view of light work conveyor with molding machines and sand hoppers to the right. Fig. 3 (Below)—View of conveyor from pouring end

EXTENT to which mechanical equipment and continuous methods may be employed to increase the productivity of a given floor area is illustrated in the plant of the Sandwich Foundry Ltd., Sandwich, Ont., where heats ranging from 160 to 200 tons are poured on a floor area originally designed for the production of between 10 and 15 tons of gray iron castings per day. In foundries operated in what long has been regarded as the standard or orthodox manner, ratio of floor area to tonnage in foundries specializing in light weight castings ranges from 500 to 1500 square feet per ton. Molds are made steadily and placed on the floor, up to a definite hour in the afternoon. At that hour the production of molds ceases. The remainder of the daily working period is devoted to the distribution of the molten iron, shaking out the molds, removal of the castings and, in many instances, the reconditioning of the sand for the following day. Under these conditions a foundry running a 200-ton daily heat would require floor space between 100,000 to 300,000 square feet.

A building or group of buildings to cover this imaginary area would vary in size from 200 x 500 feet, to 500 x 600 feet. In one large stove foundry designed to handle heats of 90 to 100 tons per day the actual floor dimensions are 135 x 1000 feet, a total of 135,000 square feet or 1350 square feet per ton of iron melted in the foundry.

With these figures in mind and still before his eye for reference, the reader may realize more readily the startling contrast to orthodox condi-

Saves Time

and

FLOOR SPACE

Fig. 5.—Ladles are filled from a tilting spout

tions presented by the Sandwich Foundry where the total floor space for molding, pouring and shaking out is 8100 square feet and where maximum daily heats of 200 tons have been poured. The ratio works out at approximately 40 square feet per ton. The explanation of course is that instead of only once, the floor is utilized many times each day and thus in effect the foundry owners get the benefit of a floor that probably approximates 500 square feet for each ton of iron melted and poured. From another viewpoint the foundry may be compared to a 10 or 12-story building, in which every floor is operated to a capacity equaling that of the first.

From the beginning, or rather since the plant was taken over by the present owners, the business has increased steadily. All the castings are made for the Ford Motor Co., of Canada which operates an assembling plant on the Canadian side of the Detroit river in Ford City about 5 miles from Sandwich from which it is separated by the town of Windsor.

For the benefit of many who are not familiar with the territory, Detroit occupies the north side of the river for many miles. It is paralleled on the south or Canadian side of the river by a

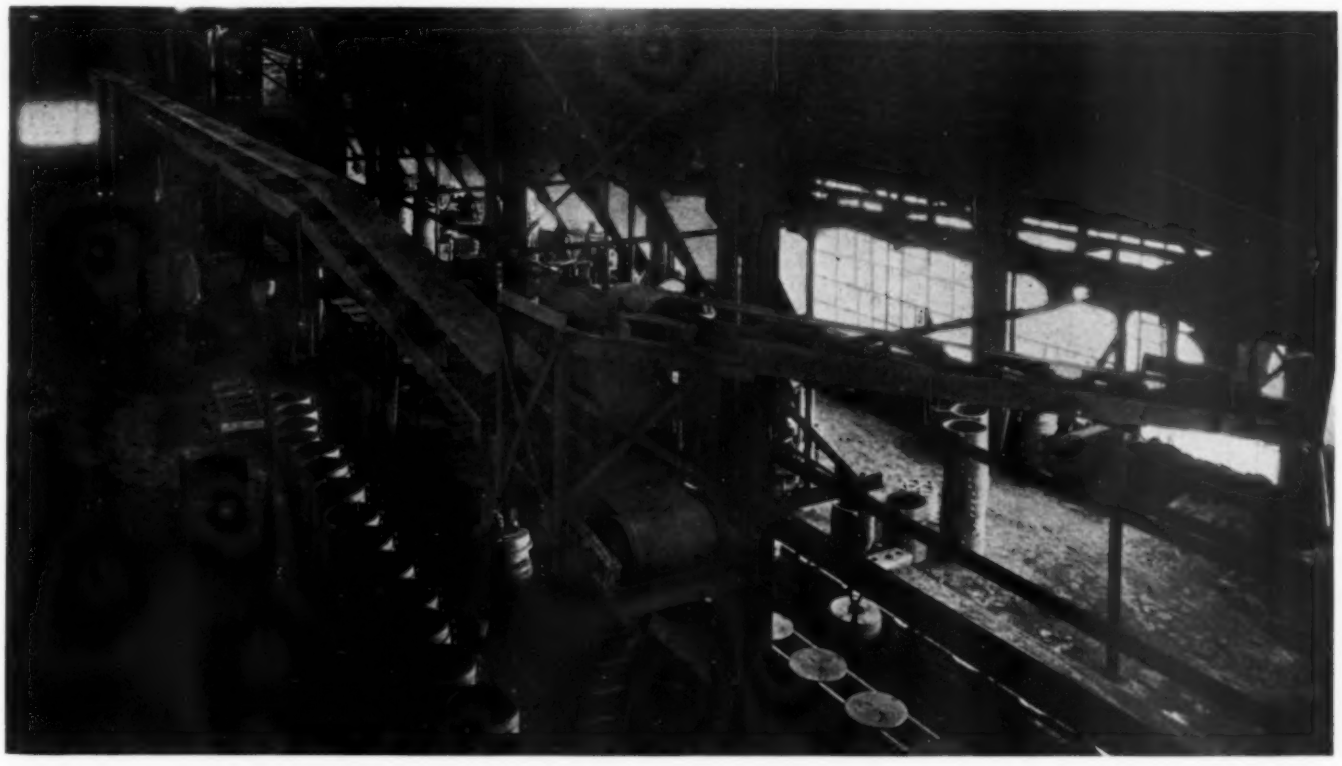


Fig. 4—General View of the Belts Which Distribute the Sand To the Stations

Fig. 6 (Left)—Mechanism for driving conveyor. Fig. 7 (Right) Molds are shaken out over a grating

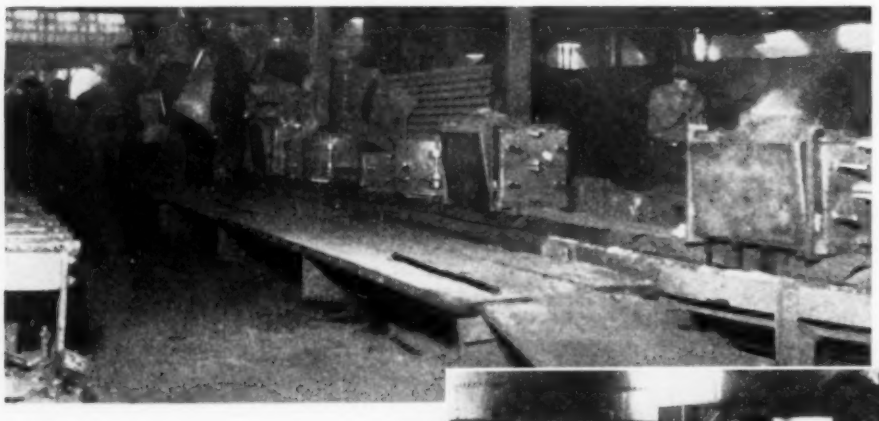
group of cities known as the Border Cities, including Sandwich, Windsor, Walkerville and Ford City, in the order named and reading up the river, in this instance from west to east. In the 3000 miles of international border line this is the only place, where, owing to a quirk in the river, Canadian territory lies south of its immediately opposing territory in the United States.

Through a combination of circumstances which do not affect the present discussion, the then Sandwich Foundry Co., went into bankruptcy in 1921 and the property was offered for sale. It attracted the attention of a group of young men who had received their training under the veteran Dan Ryan, Cleveland, and who had been sent by him to operate his company's second foundry in Ecorse, Mich., practically a suburb of Detroit and therefore only separated from Sandwich by the width of the Detroit river.

This small group of four experienced and highly skilled foundrymen acquired the Sandwich property, built up an organization, installed and practiced methods and ideas that had served them well elsewhere and soon had established a business that consistently and steadily has increased since its inception.

Early in 1927 the volume had increased to such an extent that the existing building no longer was adequate. Two alternatives presented themselves. One was to erect additional buildings. The other was to install a conveyor system in one section of the existing building and pour the iron continuously from one cupola, while operating the remainder of the shop and the second cupola in the regular manner, that is make all the molds in the early part of the day and pour them as a group later. Tentative plans also were made to install a second conveyor unit if conditions warranted and the sand handling system was designed in a manner that might be adapted if necessary to the two units.

The following year, that is in 1928, with the shop running 16 hours per day in an attempt to meet production schedules, decision was made to install the second conveyor unit and extend the shakeout and sand handling equipment to accommodate the two units. The C. O. Bartlett & Snow Co., Cleveland, designed and installed the first unit and submitted tentative plans for the second at the same time. Later, with certain mod-



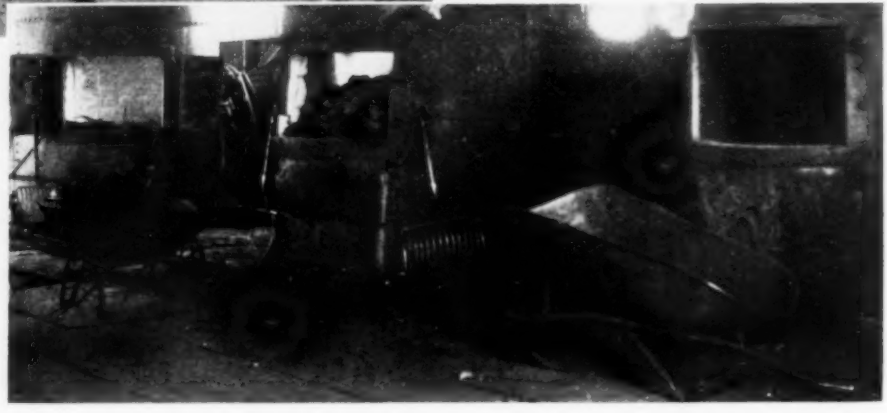
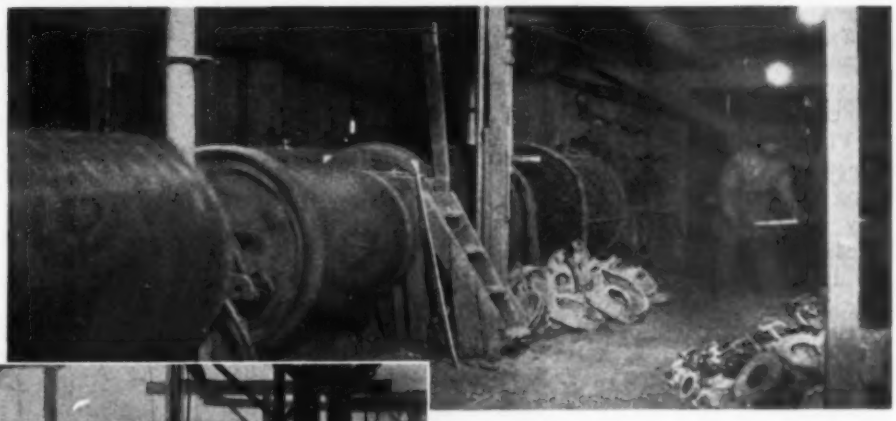


Fig. 8 (Above) Cylinder blocks and flywheels are poured from crane ladle Fig. 9 (Right)—All three cupolas are served from the same charging platform

Fig. 10 (Below)—Cylinder blocks are given preliminary cleaning in rectangular tumbling barrels
Fig. 11 (Right) — Small castings are cleaned in cylindrical barrels



ifications these plans were adopted and the C. O. Bartlett & Snow Co. installed the second unit. General layout of the conveyors and sand handling equipment as at present constituted is shown in Fig. 17.

That illustration also shows how the entire floor area is utilized, the relative position of the cupolas and the shakeout station, and the space along side one of the walls where a great many small parts still are molded and cast in a semicontinuous manner. The molds are placed on the floor in the usual manner, but on every floor the molds are poured and shaken out before any great number has accumulated. The molding machines, mostly plain squeezers, are located close to the wall and the molds are placed temporarily on the short floor which extends to the gangway. The sand is cut over by hand constantly and the same sand and floor space are used repeatedly throughout the day.

Snap flasks are employed on this class of castings which includes gear shift housing, exhaust manifold, intake manifold, speed gear housing, oil pan bearing, valve stem guide, valve chamber cover, water pump impeller clutch retaining hub, clutch pressure hub, water pump cover, cylinder head outlet connection. Metal patterns and matchplates are used throughout. Eventually a third conveyor may be installed to take care of this division.

Cylinders, flywheels and right hand clutch housings are made on the conveyor shown near the center of the illustration. The cylinders are molded on machines made by the Milwaukee Foundry Equipment Co., Milwaukee, and the Osborn Mfg. Co., Cleveland. The patterns are split on a center line

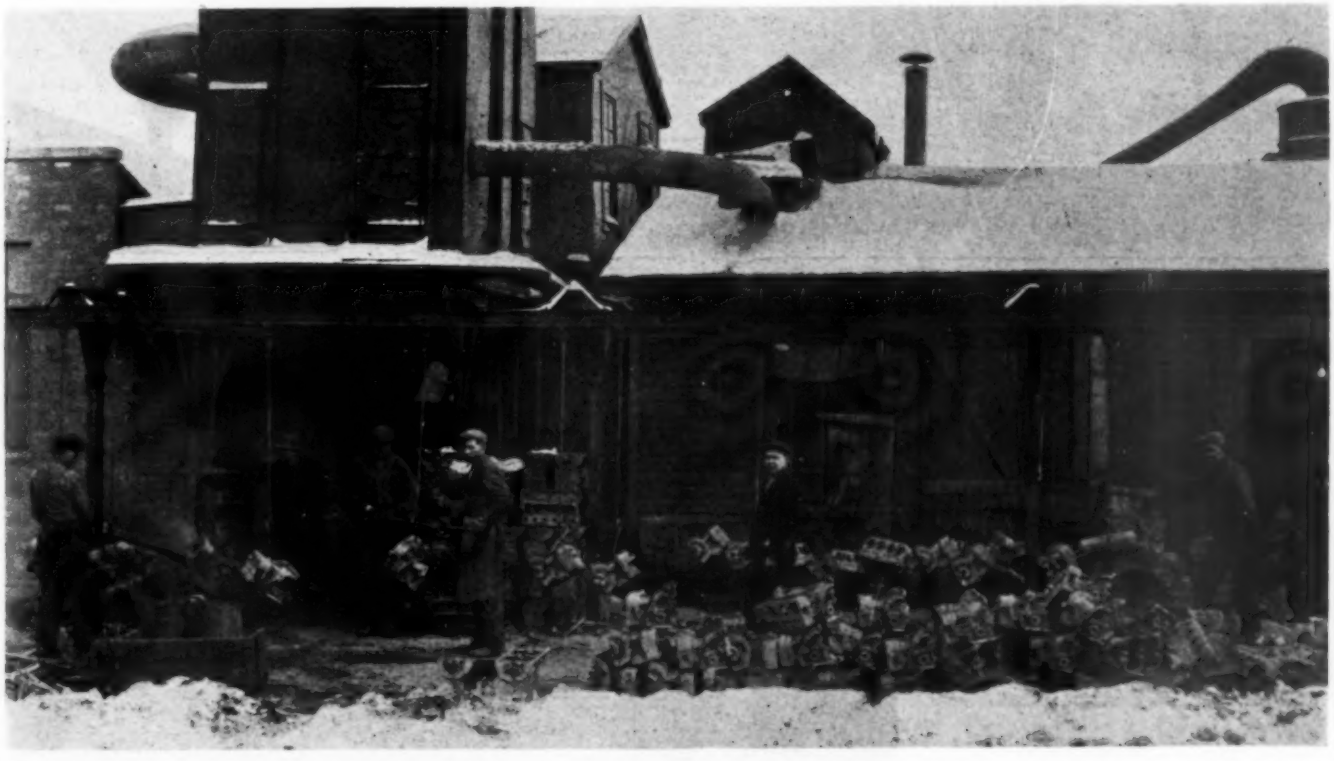


Fig. 12—Hot castings from the shakeout table are suspended by hooks from a monorail and piled outside to cool

through the barrels. The drag machines are grouped in one battery between the center and the left end of the conveyor as it appears in Fig. 17. The cope machines are grouped further along so that the operators may have time to set the cores in the drags, before the drags pass the core setting station. Present production is at the rate of 700 cylinder blocks per day.

Flywheels are made on a jolt strip machine supplied by the Wm. H. Nicholls Co. Inc., Richmond Hill, L. I., N. Y. The clutch housing mold is made on a pair of machines furnished by the Milwaukee Foundry Equipment Co., Milwaukee.

A considerable volume of the Ford output is for export trade to foreign countries where drivers still turn to the left and therefore require to have the steering gear at the right of the machine. Hence the reference to the right hand clutch housing. The left hand housing is molded on the first conveyor installed and shown near the top of the illustration Fig. 17. Other castings made on this conveyor include, clutch pressure plate, cylinder head, transmission case, front end cover and flywheel housing. They are made on a battery of 14 machines supplied by the Milwaukee Foundry Equipment Co., and three made by the Wm. H. Nicholls Co. Inc.

Fig. 13—*The hand ladle is supported on a yoke*

The light conveyor extends for a distance of 135 feet from end to end and can handle 436 molds per hour. The second conveyor is 122 feet in length and has a capacity of 186 molds per hour. On the light work conveyor unit, the molding machines are located in a long line between the conveyor and the wall. In the other conveyor unit the molding machines are located in a line in the central space between the two legs of the conveyor proper.

Metal is taken from the cupolas at one end of the foundry and distributed in 1000-pound ladles suspended from a monorail system that extends to all necessary points and is provided with switches for transferfor transferring the ladles and other loads from one line to another. Molds on the cylinder block conveyor are poured direct from the large ladle. The men handling the ladles stand on a platform which adjoins the conveyor. They move along slowly in time with the speed of the

Fig. 14 (*Right*) *Body and barrel cores are dipped half way into a blacking bath*

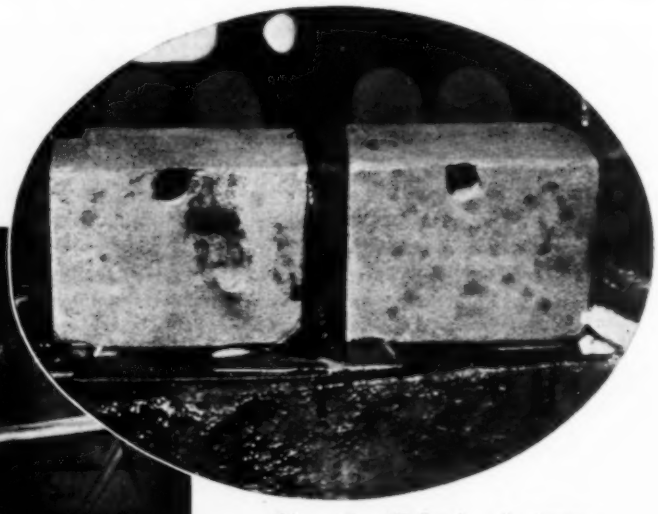


Fig. 16 (*Below*)—*A turntable in the floor facilitates loading and unloading the oven*

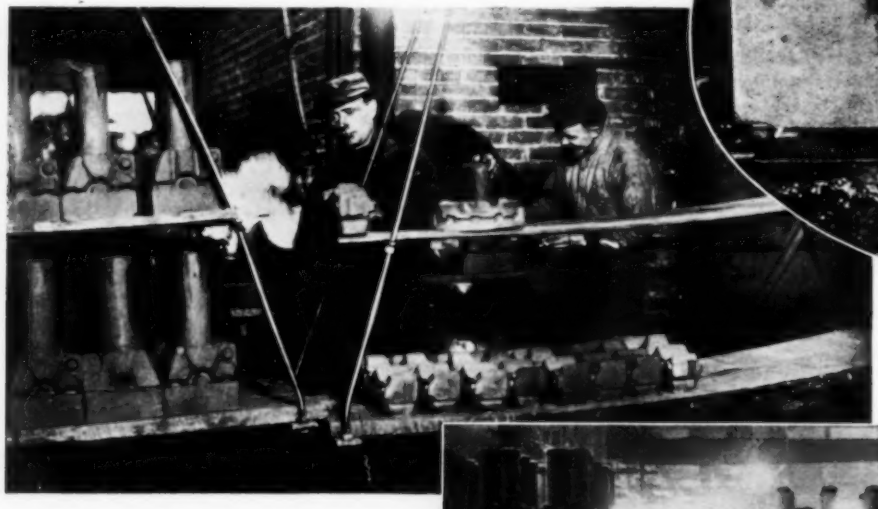


Fig. 15 (*Above*)—*Carriers suspended from a monorail take the inspected cores to the molding stations*

traveling molds which are being poured.

The poured molds travel around the loop shown at the right end of the conveyor and then pass under a hood where the steam, smoke and gas are exhausted and discharged on the outside of the building. This hood extends over the greater part of one leg of the conveyor. As the molds merge they are seized by the shakeout gang and dumped over a grating to a belt leading to the sand reconditioning station. The casting is suspended on a hook dangling from a monorail and is pushed by hand to an open space in front of the building where in company with many others it is allowed to cool. The aerates the sand, insures a thorough distribution of the moisture and incidentally lowers the temperature. The sand then falls into a large steel plate hopper with an opening at the bottom covered by a sliding door which may be adjusted to deliver any definite amount of sand within certain limits. Sand shaved off by this sliding door or plow falls into a bucket elevator which again carries it aloft and deposits it in a continuous stream on the main belt traveling over the steel hoppers which serve the molding machines.

The sand distribution system is shown in Fig. 17, commencing at the upper left corner. The upper belt Northern Engineering Works, Detroit, are lined to 48 inches inside diameter and are charged with iron and coke, 1000 pounds of iron to 150 pounds of coke. A limestone flux is employed in all cupolas, 65 pounds of limestone to the ton of iron.

Two elevators serve the cupola charging platform and the materials entering the cupolas are weighed on two platform scales made by the Toledo Scale Co., Toledo, O. Pig iron, gray iron and steel scrap, coke and limestone are charged into the cupolas by hand.

Gates, sprues, and miscellaneous scrap which accumulate in the foundry during the day's operation are col-

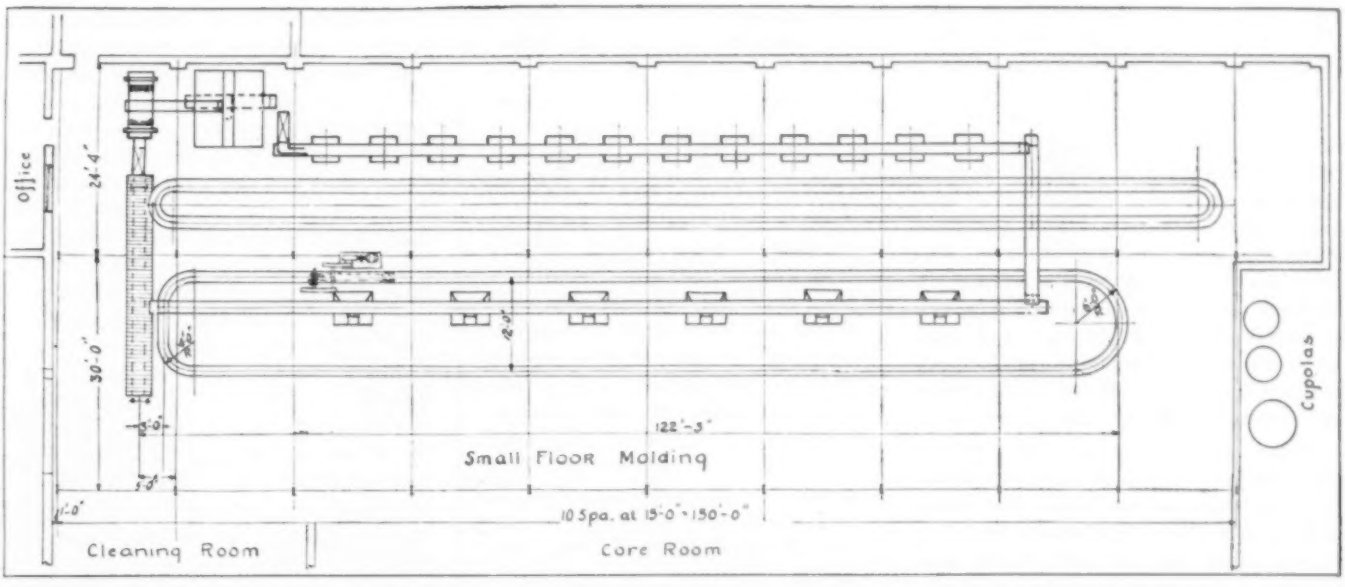


Fig. 17—General layout showing position of the two conveyors and sand distribution equipment

empty flasks are returned to the molding stations.

A slightly different practice is pursued in pouring the castings on the second conveyor. The molten metal is brought to the pouring end of the conveyor in the 1000-pound ladles and there it is transferred to hand ladles, a little larger than those usually employed. They are supported in yokes suspended from the monorail and therefore impose no burden upon the two men who pour all the molds coming around the end of the conveyor. The poured molds are carried to the opposite end and are dumped over a continuation of the same grating that serves the other conveyor.

A moving belt carries the sand from the shakeout to a bucket elevator which takes it aloft and discharges it into a revolving screen and thence on to a short transverse belt where the necessary amount of water is added. The reconditioned sand falls from the end of the belt on to a rapidly revolving lantern wheel which travels toward the right, fills the various sand hoppers shown and then discharges sand on to the short transverse belt at the right end. This belt carries the sand to the long belt shown over the center of the second conveyor unit. Any sand remaining on the belt after the second set of hoppers has been filled, falls from the end of the belt into a chute which directs it into the shakeout grating. Any necessary new sand additions also are made through this grating. In this manner the sand constantly is kept in circulation and also is kept under perfect control.

Three cupolas located at one end of the building as shown in Fig. 17 are available for melting the iron. Usually one is held as a spare, while all the iron required is melted in the other two. The largest of the three is lined to 60 inches diameter. It was built by the Whiting Corp., Harvey, Ill., and is charged with coke and iron in the proportion of 2000 pounds of iron to 250 pounds of coke. The two smaller cupolas, built by the lected in steel pans and lifted by the crane to a part of the charging platform extending into one of the foundry bays above the cupola spouts.

A boshed lining has been found most effective and economical on these cupolas running long heats. The greater part of the three rows of blocks constituting the restricted area burn away each day. They are replaced at night and in that manner the main lining is not affected.

Cores are made from a lake sand bonded with oil and prepared in two revolving paddle mixers made by the Standard Sand & Machine Co., Cleveland. All the miscellaneous small cores are dried in one single and one double battery of gas fired ovens made by the Marshall Blowpipe Co., Detroit. Each battery is made up of seven compartments in which the cores are supported on racks.

Barrel and body cores are made in combination. Thus two barrel cores and half the crankcase core forms a unit. Two of these units are placed

(*Continued on Page* 329)

BLAST FURNACE
Operation Affects Quality
of Pig Iron and Castings

By A. L. Boegehold

Part I

THERE is probably no raw material used in the foundry which has received more blame for defective castings, than pig iron. It always has been a peculiarity of human nature to be suspicious of the unkown and that is why pig iron is regarded as a bad character. There have been, no doubt, many occasions when pig iron has been held responsible for some casting defect simply because of lack of adequate evidence to establish its innocence. Pig iron also probably has been pronounced guilty of causing defects many times by virtue of rather flimsy evidence.

What percentage of the defects attributed to pig iron are warranted is hard to determine. Also, how many defects are there for which pig iron is the cause without ever being suspected? There are a number of defects common to gray iron castings which might be caused either by the use of the wrong pig iron or by a divergence from proper procedure in melting, charging, molding, etc. For example, a few of such defects are: Hard edges, hard iron, porosity, cracked castings, soft castings, and low combined carbon.

An epidemic of any of these or similar defects is the signal for a careful checking up on analysis of melting stock, proportions of charge, details of cupola operation, casting temperature, and other foundry details.

If the cause is not discovered in the foundry practice, the manager, as a last resort, will change the pig iron in the charge. If the pig iron is the cause, this procedure may stop the trouble, but then again it may not, if the substituted pig iron possesses the same defect in its make-up. The trouble is we have no criterion for the selection of pig iron—no yardstick with which to determine whether a pig iron will or will not cause certain defects in our castings.

There has been a great deal of discussion in the past three years at meetings of the American Foundrymen's association and American Institute of Mining and Metallurgical Engineers on the quality of pig iron and on the effect of that quality upon the quality of castings made therefrom. In the course of this discussion there has been praise for the pig iron made years ago and also denunciation of the same. Blast-furnace men have pointed to the improvement in blast-furnace operation which has taken place in the past 20 years, so that

Gives Test Conditions

THIS article, which is the first of a series of four, gives the conditions under which the pig iron was melted, and the various tests to which the cast iron produced was submitted. Blast furnace data on the pig irons chosen also are discussed. The paper was presented at the Chicago convention of the American Foundrymen's association, held April 8 to 11. The author, A. L. Boegehold, is a metallurgist for the General Motors Corp., Detroit.

FIG. 1—A VIEW OF THE EXPERIMENTAL FOUNDRY WHERE THE VARIOUS KINDS OF PIG IRON WERE TESTED BY CASTING INTO FLYWHEELS

now there is a much smaller possibility of producing bad pig iron than there was when blast-furnace operation was in a much cruder state. At the conclusion of all this discussion I know there were many foundrymen who were more at sea than ever on the question of good and bad pig iron. A few were ready to believe that the trouble was not in the pig iron but in its use.

Foundry managers of General Motors Corp. divisions were interested just as deeply in this question as others in the profession, so they asked that an investigation be conducted to clear up some of the mystery about pig iron. Steps were therefore taken to set a small foundry in operation but one large enough to simulate conditions occurring in production foundries so that pig irons from various blast furnaces could be melted as part of the cupola charge going to make gray iron for automotive castings. Fig. 1 shows the foundry in operation. Gray iron made from these various pig irons was subjected to a variety of tests to determine the relation between the properties of the cast iron and the conditions of operation during the manufacture of the pig iron.

In brief, the method of investigation consisted of making a series of physical tests upon cast irons of the same analysis poured at the same temperature and made under similar conditions from pig irons of the same chemical specifications obtained at different times from different blast furnaces and whose blast-furnace history was known as completely as possible. The variation in properties of the cast irons obtained was taken as an indication of differences in quality of the pig iron used. The following details pertain to the method of procedure.

Eleven casts of about 75 tons each of No. 2X malleable pig iron, containing silicon as near 2.50 per cent as possible, were obtained from seven different blast furnaces over a period of a year. During the manufacture of these samples a record was made of all blast furnace operating conditions which could be obtained. A typical data sheet is shown in Table I.

Tests made on each of these pig irons were as follow:

Chemical Analysis.
Microstructure.
Fracture.
Dilation Characteristics.
Spectrum Analysis.

These pig irons were used as raw material for the production of cast iron flywheels. The analysis aimed at for these castings follows:

Element	Per Cent
Carbon	3.00-3.30
Silicon	2.25-2.35
Manganese	0.55-0.75
Sulphur	0.10 max.
Phosphorus	0.20 max.

Pig iron being the subject investigated, it was necessary to maintain all cupola conditions with as little variation as possible. The standard melting conditions which we tried to maintain at all times were:

(a) Charge—1000 pounds containing 500 pounds pig iron of the particular cast being tested.
137 pounds steel (low carbon punch press scrap).
250 pounds gates and sprues from the cupola heat of the day before.
113 pounds 7 per cent silicon silvery iron.
125 pounds coke.

Test specimens were not cast until more than three days after changing to the use of a new cast of pig iron to get the effect of the back scrap containing the new pig iron.

(b) Coke—Burning rate to be less than 3.5 minutes for 250 degrees Fahr. temperature rise and minimum temperature rise of 270 degrees Fahr. (The coke test will be presented in Part IV.)

(c) Blast—1300 cubic feet per minute. Atmospheric temperature, pressure and humidity readings were made during every heat. Coke bed 36 inches above tuyeres.

Table I

Pig Iron—Blast Furnace Data

G.M. Purchase Order No. ..... G. M. Research Lot No. .....
1. Furnace No. ..... Location .....
2. Superintendent ..... Date Produced .....
3. Heat No. ..... Type Charging Top .....
4. Ore Charge ..... lbs. Coke Charge ..... lbs. Ratio .....

	Pounds	*Per Cent*
Kind of Ore	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

6. Kind of Coke .....

	Analysis
1. Shatter Test	Fixed Carbon .....
2. True sp. gr.	Vol. Hydro C. .....
3. App. sp. gr.	Ash .....
Porosity	Sulphur .....
	Water .....

7. Dry-Wet Blast?
8. Blast Temp. ..... max. ..... min. ..... cycle.
9. Blast Pressure ..... lbs. sq. in. ..... lbs. sq. in. max. ..... lbs. sq. in. min.
10. Air per hour ..... cu. ft. ..... lbs.
11. Fuel burnt per hr. ..... lbs. ..... lbs. per sq. ft. area at max. dia.
12. Pounds of air per lb. of fuel ..... Air per lb. of carbon ..... lbs.
13. Blast velocity through tuyeres ..... ft. per min.
14. Composition of Top Cases ..... % CO ..... % CO_2 ..... % H .... % N
15. Temperature of Top Cases .....
16. Burden per hr. ..... lbs. ..... lbs. per sq. ft. area at max. dia.
17. Composition of slag.

	Flushing Slag	*Casting Slag*	
SiO_2	.....	.....	
Al_2O_3	.....	.....	Appearance of Slag .....
CaO	.....	.....	
MnO	.....	.....	
FeO	.....	.....	Slag per ton of iron produced ..... lbs.
MgO	.....	.....	
CaS	.....	.....	

18. Weight iron produced per hour ..... lbs.
Weight per sq. ft. area at max. dia. per hour ..... lbs.
19. Depth of metal in hearth at tapping ..... ft.
20. Casting Temp. ..... °F
Average ..... °F.
21. Time between cast ..... hours.
22. Dimensions of Furnace.
1. Stock line to tuyeres ..... ft., ... in.
2. Tuyere level to hearth ..... ft., ... in.
3. Size and number of tuyeres .....
4. Iron notch to cinder notch ..... ft., ... in.
5. Dia. at top of bosh ..... ft., ... in.; straight .... ft., ... in.
6. Dia. at hearth ..... ft., ... in.
7. Cubical contents of furnace ..... cu. ft.
23. Chemical Analysis:

	Average of Five Pigs				
T.C.	C.C.	Mn.	P.	S.	Si.
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

24. Atmosphere Temperature ..... °F.
25. Barometric Pressure ..... inches Hg.
26. Humidity ..... % ..... gr. per cu. ft.

Table II

Variation of Iron Production

Pig lot No.	Combustibility of Coke — Ignition Temp.	Total Temp. rise	Time in minutes for 250 ° F. Temp. rise	Pounds of iron produced per hr. per sq. ft. area of furnace
11	860-930	269	7.0	96.2
2	930-1080	266	3.2	99.8
6	990-1070	278	2.3	135.0
7	860-915	318	2.2	179.0

The cast iron produced in this manner was poured into a variety of physical test samples designed to permit the measurement of

(a) Tensile strength of 1¼-inch diameter bar as cast.
(b) Tensile strength of ⅝-inch diameter bar as cast.
(c) Transverse strength of 1¼-inch round by 12 inches bar.
(d) Hardness of various sizes of section cast in green sand and in core sand.
(e) Machinability of ⅜, ¾ and 1¼-inch slabs.
(f) Fluidity.
(g) Volume shrinkage.
(i) Linear shrinkage.
(j) Density.
(k) Microstructure.

In conducting an investigation of pig iron, the ideal course naturally is to maintain all variables constant. Practically, that is quite impossible to accomplish, due to inability to regulate some of the factors, including:

1. Amount of water in the atmosphere.
2. Temperature of the atmosphere.
3. Pressure of the atmosphere.
4. Variation of several properties of pig iron due to variable blast furnace conditions.

The best we can do is to record these items and take them into consideration in our conclusions. Another variable affecting the results of our physical tests on the cast iron is the variation in silicon content. In spite of precautions taken to distribute the charge properly and always to leave about 300 pounds of metal in the well of the cupola, there was a variation in silicon content from heat to heat. This of course is a difficulty common to all foundries, unless special equipment, such as mixers or large forehearths are installed to remedy this condition. However this variation in silicon was used in studying effect of silicon upon hardness and was taken into consideration in forming other conclusions.

After collecting the data at the blast furnace during the production of each of our sample casts of pig iron, the information was used to calculate performance values. The results of these calculations are tabulated on a summary sheet shown as Table III. Study of this sheet will bring home to you the great variation in the methods existing at various furnaces in the production of the same kind of pig iron.

The conversion of iron ore to iron is a chemical process and the nature of the resulting product is determined by the kind of chemical reactions occurring in the blast furnace and how far towards equilibrium those reactions progress. At the high temperatures existing inside the furnace, reactions proceed at great rapidity. Therefore, small differences in time of contact of the chemical compounds, as well as variations in chemical and physical environment in which the major reactions of ore and silica reduction occur, will produce considerable difference in the character of the end product.

We have known in a general way that there is considerable variation in conditions related to blast-furnace operation but have most users of pig iron ever really appreciated just how much these conditions do fluctuate? Possibly if this point is realized more thoroughly it will begin to be apparent that pig irons which seem to be the same when viewed from the standpoint of chemical analysis, must be subject to considerable variation in physical character due to the constant fluctuation of the blast furnace operating conditions. If means for reducing the amount of these fluctuations are available, it behooves the blast furnace operator to make use of them that he may have better control of the quality of his product.

In the first place we know that coke varies tremendously. Coke in itself is

Table III

Blast Furnace Operating Data

Heat No. and Furnace	1A	2A	3A	4A	5B	6C	7D	8E	9E	10F	11G
Lbs. coke per long ton iron produced	2160	2130	1930	2000	2120	1845	1860	2440	1765	2170	2000
Lbs. iron produced per hr. per sq. ft. area	121.3	99.8	122.0	115.0	113.5	135.3	179.0	195.8	117.0	123.0	96.2
Lbs. burden descending per hr. per sq. ft. area	228.0	178.5	221.2	234.5	229.8	270.0	363.5	212.0	214.5	243.0	179.2
Lbs. coke burnt per hr. per sq. ft. area	117.1	94.9	105.1	102.5	107.5	111.0	148.2	104.2	92.7	119.4	84.5
Lbs. air per lb. carbon in coke	4.53	5.25	4.55	4.98	5.37	4.27	4.48	5.68	6.30	5.52	6.03
Lbs. air per lb. of burden	2.11	2.54	1.96	2.00	2.30	1.64	1.67	2.46	2.41	2.46	2.41
Lbs. air per hr. per sq. ft. area at max. dia.	482	452	437	468	526	443	606	522	516	574	432
Lbs. air per lb. of iron produced	3.98	4.53	3.58	4.07	4.66	3.29	3.39	5.45	4.42	4.66	4.60
Grains water per cu. ft. of air	3.2	6.1	2.6	2.2	2.7	1.56	2.3	1.51	2.8	1.75	1.3
Lbs. water in blast per ton iron produced	55.0	121.6	38.5	35.5	53.2	22.0	32.0	34.0	51.8	33.0	23.8
Blast temperature	1185±175	1300±100	1275±125	1130±130	1170±80	1050±50	1050±50	1110±150	1100±150	1075±265	1100±150
Blast pressure, lb. per sq. in.	9.5-12.0	11.0-13.0	10.5-11.0	9.0	13.5-19.5	14.0-18.0	12.0-14.0	11.5	11.0	13.5	13.5
Per cent ore in burden	85.60	91.40	89.90	81.5	100.0	85.79	90.31	90.0	90.0	91.7	88.9
Per cent sintered flue dust in burden	8.38	3.45	10.10	10.8	0.0	8.17	2.14	10.0	10.0	8.3	11.1
Per cent foreign scrap in burden	6.02	5.15	0.0	7.7	0.0	6.04	7.55	0.0	0.0	0.0	0.0
Per cent SiO_2 in slag	38.56	37.54	35.24	42.60	40.44	40.20	38.80	33.40	35.6	35.8	39.93
Per cent Al_2O_3 in slag	11.40	14.45	13.34	10.34	10.10	14.05	11.54	16.00	16.20	15.30	13.31
Per cent CaO and MgO in slag	45.88	42.62	47.24	....	45.98	42.38	47.04	48.07	45.67	47.62	37.77
Appearance in slag	.....	Acid	Basic	Acid	.....	Acid	Acid	Basic	Acid	Basic	Acid
Lbs. of slag per ton of iron	1215	1100	1108	1272	1282	1345	1070	1222	1044	1170	1205
Casting temperature of iron	....	2617-2670	2650-2790	.....	2635-2660	2633-2710	2650-2750	2705	2783	2668	2707

responsible for some of the worst variations that occur in blast-furnace operation, as may be seen by examining data tabulated as Table III. In this table information is given on blast-furnace conditions existing during the manufacture of the 11 casts of pig iron obtained from seven different blast furnaces. The heats of iron are identified by numbers from 1 to 11 and the blast furnaces in which the iron was made are distinguished by letters from A to G.

Starting at the first item, the pounds coke used per ton of iron produced, one of the things which all blast furnace operators keep close check on, shows great variation from 1765 to 2440 pounds and it happens that this variation was in one furnace in one week's time. If it was necessary to use 2440 pounds of coke to get enough heat to produce 2.50 per cent silicon iron, then there must have been a tremendous difference in the coke used or in some other factor when with 1765 pounds of coke per ton of iron enough heat was supplied to obtain 2.33 per cent silicon. Some of this discrepancy is due probably to the difference in slag composition being basic in one case and acid in the other. (See information of Table III on appearance of slag.)

To compare the operation of the different blast furnaces on a uniform basis, the quantities of air, ore, coke, etc., flowing through the furnace are reduced to quantities per one square foot of furnace cross-sectional area at the maximum diameter which is at the top of the bosh. This basis makes the data directly comparable and shows rate of material flow per unit, giving a different picture from that obtained by comparing total furnace data. The great difference in operation of furnaces studied is astonishing.

The third item in Table III gives the pounds of burden descending per hour in each vertical column of one square foot cross-sectional area. This speed of travel varies from 178.5 pounds during production of lot 2 to 363.5 pounds during production of lot 7. The latter rate was attained in a furnace only 68 feet from hearth to stock line, while the former was in a 72 foot furnace. When we take into consideration the height of the furnace in determining the relative time that any particle of ore remains in the furnace, we find that each particle of burden remained in *A* furnace while making heat No. 2, 2.16 times as long as the burden remained in *D* furnace while making heat 7. If the proper amount of time to reduce iron ore was used in *G* furnace, then certainly insufficient time has been allowed for complete reduction of the ore while making heat 7 in *D* furnace. The time of the ore in the furnace in making the other 9 heats, falls between these two cases cited.

The rate of travel of this burden of course depends on the rate of coke combustion. If a readily combustible coke is used, the rate of coke combustion is determined by the rate at which air is supplied. Increasing the speed of combustion by faster delivery of air is possible only up to the maximum burning rate of the coke. This maximum burning rate varies widely among different cokes, and even among cokes which are accepted as being alike on the basis of analysis and percentages of cell space. The performance of the various furnaces indicates that due to the combustible quality of the coke in some instances, blowing in large quantities of air speeds up combustion and burden travel, while in other cases increasing the air does not speed up combustion simply because the coke is not a fast burning coke and will not respond to the increase in blast volume. The differences in combustibility of cokes are illustrated well by curves of Fig. 2 obtained by testing these cokes by the test described in Part IV of this series of articles.

Combustibility characteristics of six cokes are shown in the graph of Fig. 2. Four of these are cokes used in the blast furnaces while making the casts of pig iron obtained for this investigation. It is obvious that a coke possessing the characteristics shown in curve 6 where it takes 8.0 minutes to liberate enough heat to raise the temperature 250 degrees Fahr. when burned with oxygen, cannot be made to burn in a blast furnace as fast as a coke having the character shown by curve 4 where a 250-degree Fahr. temperature rise is obtained in 2.0 minutes.

Table II shows how the rate of iron production varies with the quality of the coke. The combustibility results represent averages of six test runs on each coke. It is quite apparent that a fast burning coke is a requisite for rapid production of pig iron.

Foundrymen are using pig iron made to the same chemical specifications, but under widely differing blast furnace conditions, due to the use of cokes as different as these illustrated. It is quite probable that the properties of the resultant cast iron reflects these variations in some way.

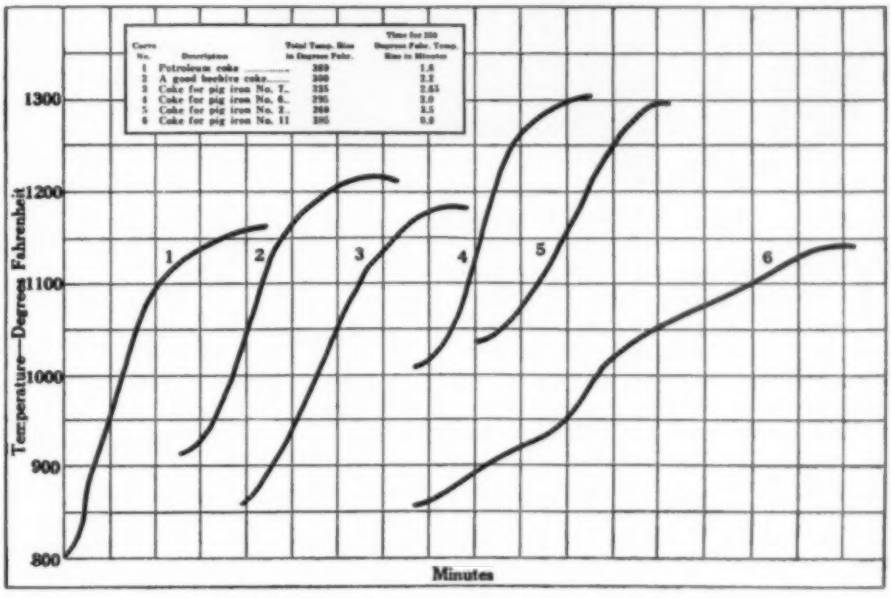
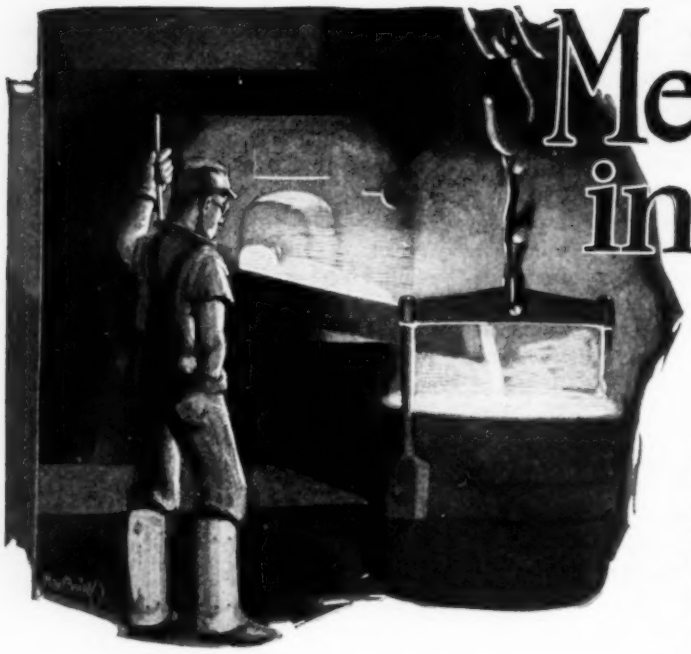


FIG. 2—COMBUSTIBILITY OF VARIOUS KINDS OF COKE

In the case of heat 6, furnace *C* and heat 7, furnace *D*, the air used per pound of coke carbon was about the same, viz., 4.27 and 4.48 pounds of air per pound carbon in coke, but the coke burnt per hour in furnace *C* was 111 pounds as against 148.2 pounds in furnace *D*. This was due simply to the fact that air was supplied faster to furnace *D* because the coke was capable of rapid combustion the heat was produced and utilized at a faster rate.

In furnace *D* 606 pounds of air per hour per square foot of area were supplied while in furnace *C* only 443 pounds were supplied per hour per square foot area. The reason for the use of about equal amounts of air per pound of carbon is found in the similarity of combustibility character of the two cokes as shown by com-

(*Concluded on Page* 330)



Melting Iron in the Cupola

Part XVI

By J.E.Hurst

TWO types of blowing apparatus are in common use today for supplying air at the comparatively low pressures required by the cupola. The two types are described respectively as positive pressure blowers and centrifugal fan blowers. In the former, the delivery of air by the machine is independent, within limits, of the resistance opposed to the air stream. In the latter the quantity of air delivered varies with the resistance offered. Fans are more sensitive to the effects of furnace obstruction. For large furnaces where considerable resistance is offered by the stock the positive pressure blower is favored by many. This distinction holds today with considerably less force than it did a few years ago. Almost universal adoption of electric motive power, developments in the construction of both centrifugal fans and motors during recent years have combined to make the fan a worthy competitor of the positive pressure blower even on large cupolas.

The reciprocating blowing engine or air forcing pump has given way entirely to the rotary type of positive pressure blowing apparatus for foundry cupolas. Three principal types of rotary blowers for this purpose are distinguished by the form and disposition of the impellers. The simplest type indicated in section in Fig. 102 consists of a cast iron casing, *A*, provided with flanged inlet and exit pipe connections *B* and *C*. A hollow sectional cylinder indicated at *D*, is mounted on a shaft *E* to revolve eccentrically with reference to the casing *A*, and in running contact with the casing at *F*. Two plate-like impellers mounted in suitable slots in the casing *G* and *H*, slide in and out of the slots during the revolution of the drum and transfer the air from the inlet *B* to the outlet *A*. This type of blower is used only in small sizes and is not used extensively for cupola blowing.

Construction and operation of the Roots blower is clearly indicated in the interior view of this machine, Fig. 103. Two impellers mounted on parallel shafts rotate in opposite directions. Relation of impellers to each other is maintained accurately throughout the revolution by timing gears, one on the end of each shaft. Shape of these impellers insures a definite, accurately gaged clearance at the contact line at all times. They revolve without internal friction, and no internal lubrication is required for the blower.

When an impeller is in the position in which one tip has just cut off the

Volume Is Regulated

MARKED difference of efficiency between the two main classes of blowers has disappeared to a considerable extent owing to the universal adoption of electric driving equipment and to the many improvements in centrifugal fan design and construction. Measurement of air volume is a factor of considerable importance in cupola operation. On positive pressure blowers the calculation is based on the number of shaft revolutions. A simple U-tube partly filled with liquid, one end open to the atmosphere and the other end connected by suitable pipe to the wind box, registers the air pressure in ounces, inches or pounds on a scale.

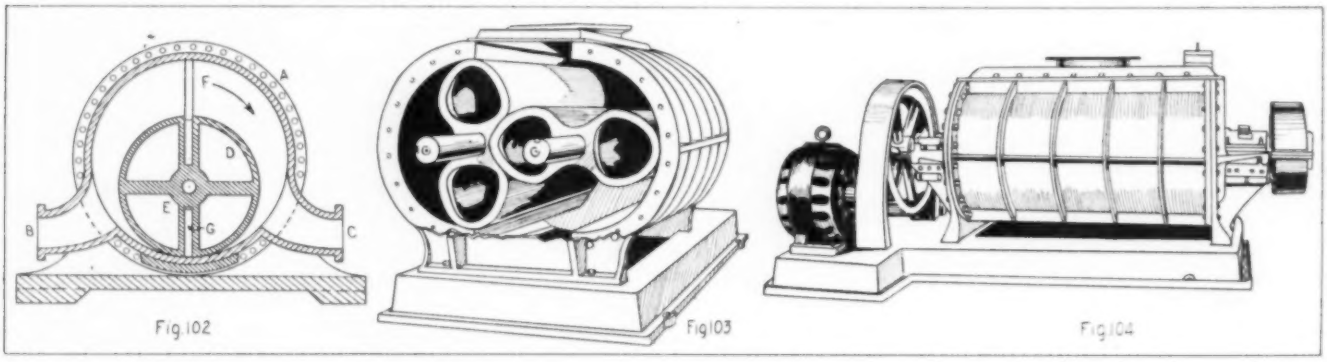


FIG. 102—LEFT, SIMPLE POSITIVE PRESSURE BLOWER. FIG. 103—CENTER, INTERIOR VIEW OF ROOTS TYPE ROTARY BLOWER SHOWING TANGENT AIR IMPELLERS AND THE SIMPLE, RUGGED CONSTRUCTION. FIG. 104— RIGHT, COMPLETE BLOWER AND MOTOR ASSEMBLY

opening to the suction side, and the opposite tip is ready to open to the discharge side, a volume of air is trapped between the impeller and the case, which is not open to either the suction or the discharge. As the impeller continues to rotate it opens to the discharge and pushes the enclosed volume of air positively into the discharge system. The action is repeated twice for each revolution of an impeller or four times for each revolution of the blower.

Clearance between the tips of the impellers and the casing of the blower is slight. They are made practically air tight by a mixture of tallow and plumbago in the proportion of 3 to 1. Actual contact does not exist between the impeller tips and therefore the slip is reduced to a minimum amount.

Table XIX

Capacities and Outputs of Baker Blowers

No.	Displacement in cubic feet per revolution	R.P.M.	Weight of iron melted per hour tons	Internal Diam. for which blower is suitable—inches	Cubic feet passed per hour	Diameter of outlet inches
¼	0.75	250	.....	.....	11,250	3.75
½	1.5	250	0.5	14-18	22,500	3.75
1	3	240	1	18-22	43,200	6
2	6	200	2	22-27	72,000	9
3	9	175	2½	27-30	94,500	9.5
4	13	165	3	30-34	128,700	11.5
4½	17	150	5	34-40	153,000	11.5
5	25	140	8	40-48	210,000	15
5½	30	130	10	48-52	334,000	16.5
6	45	130	14	50-62	451,000	20.75
7	60	130	20	62-72	468,000	24
7½	72	130	22	62-72	561,600	24
8	100	130	28	72-90	780,000	28

drive is used, the pulley on the driven shaft preferably is supported by an outboard bearing of suitable material.

Table XVIII

Capacities and Outputs of Standard Roots Blowers

No.	Cupola Size Inside Diameter	Cupola Size Capacity Tons per Hour	Blower Speed R.P.M.	Net Capacity Cubic Feet per Minute	Brake Horsepower 8 oz.	Brake Horsepower 12 oz.	Brake Horsepower 16 oz.	Size Outlet Inches
	21	1	220	500	1.5	2.3	3.1	
1	23	1¼	260	625	1.9	2.8	3.8	8
	24	1½	300	750	2.1	3.2	4.2	
	27	2	390	1000	2.7	4.1	5.5	
	24	1½	200	750	2.3	3.4	4.6	
2	27	2	255	1000	2.9	4.8	5.2	10
	30	3½	410	1750	4.7	7.0	9.3	
	28	2½	185	1250	3.7	5.5	7.3	
3	30	3½	245	1750	4.6	6.9	9.2	12
	32	5	335	2500	6.6	9.9	13.2	
	33	5	220	2500	6.9	10.3	13.7	
4	37	6	260	3000	8.0	12.1	16.1	14
	42	7	295	3500	9.2	13.7	18.3	
	42	7	205	3500	9.5	14.3	19.0	
5	45	8	230	4000	10.7	16.1	21.4	16
	48	10	280	5000	13.0	19.5	26.0	
	48	10	195	5000	13.0	19.5	26.0	
5½	54	12	230	6000	15.4	23.1	30.8	18
	58	13	250	6500	16.7	25.1	33.4	
	54	12	170	6000	15.5	23.3	31.0	
6	60	14	195	7000	18.3	27.4	36.6	20
	64	16	220	8000	20.1	30.2	40.2	
	62	15	155	7500	18.8	28.2	37.6	
6½	66	18	185	9000	22.5	33.7	44.9	22
	72	21	215	10500	26.1	39.2	52.2	
	66	18	155	9000	22.7	34.1	45.4	
7	72	21	180	10500	26.3	39.4	52.6	24
	78	24	205	12000	30.0	45.0	60.0	
	72	21	140	10500	26.9	40.3	53.7	
7½	78	24	155	12000	29.8	44.6	59.5	28
	84	28	180	14000	34.5	51.9	69.1	
	84	28	135	14000	35.7	53.5	71.3	
8	87	30	140	15000	37.0	55.5	74.0	30
	90	33	155	16500	40.9	61.4	81.8	
	2-66	36	170	18000	44.8	67.4	89.7	

Needless to say, great care is required in the accurate machining, fitting, balancing and tuning of the parts. Good and thorough workmanship is called for in the construction of these machines. Blowers can be operated by any convenient form of power. Belt drive from a motor, engine or lineshaft is the most popular although the tendency now is to adopt direct electric motor drive. The motor is mounted on an extended bed plate and direct connected to the driven shaft by a gear and pinion. A complete motor-driven assembly is illustrated in Fig. 104. Where a belt

Blowers generally are arranged for top discharge with a weighted relief valve mounted on the discharge pipe plate and with an opening on the suction side the entire length of the impellers. The blower can be arranged for bottom discharge with the relief valve in the pipe line. Rated capacities of Roots' foundry cupola blowers are given in Table XVIII, also brake horsepower at pressures of 8, 12 and 16 ounces. Under favorable conditions, efficiency of these blowers is as high as 85 per cent and under general foundry conditions, 66 to 70 per cent. Power required can be ascertained from the relation:

$$BHP = \frac{V \times P}{33{,}000}$$

Where V = Volume of air in cubic feet per minute,

P = Pressure in pounds per square foot.

Values obtained from this relation multiplied by 1.5 will give a sufficiently close approximation to the actual power required.

In the Baker blower, illustrated in Fig. 105, the impellers attached to the upper rotating drum sweep out the volume of air included in the hollows of the two crescent shaped drums during the rotation. For the same air delivery, this machine runs at a lower speed than the Roots blower, but the power consumption is approximately the same. Rated capacities of standard sizes are given in Table XIX.

Rotary blowers should be mounted on rigid foundations and great care

Table XX

Conversion Table for Ounces and Inches

One inch of water	= 0.58 ounces (approximately) per square inch
One inch of water	= 0.03625 pounds (approximately) per square inch
One pound per square inch	=27.6 inches of water
One inch mercury	= 8.00 ounces (approximately) per square inch
One inch mercury	= 0.5 pound (approximately) per square inch
One pound per square inch	= 2.00 inches mercury
One inch carbon tetrachloride	= 0.94 ounces per square inch
One inch carbon tetrachloride	= 0.5875 pounds per square inch
One pound per square inch	=17.00 inches carbon tetrachloride
One ounce per square inch	= 1.62 inches carbon tetrachloride

Table XXI

Centrifugal Compression Ratings

Cubic Feet Free Air Per Minute	H. P. of Motor	Approximate Ship. Wt. in Lb. A-c.	D-c.	Cubic Feet Free Air Per Minute	H. P. of Motor	Approximate Ship. Wt. in Lb. A-c.	D-c.
0.75 Lb. Pressure per Sq. in.—3500 R.P.M.				1.25 Lb. Pressure per Sq. In.—3500 R.P.M.			
600	3	1120	1400	900	8	1340	1540
1100	5	1310	1600	1500	12	1635	1835
1600	8	1750	1945	2300	18	2045	2625
2100	10	1935	.....	3500	27	2250	2755
2400	12	.....	2135	5300	40	3410	3700
4000	18	2340	2885	7500	58	4115	4900
5300	27	2745	3135	10500	85	5460	6185
7300	40	3835	4410	16000	120	6675	.....
10600	58	5660	6585	21000	170	9100	.....
14200	85	7175	8350	.....	.....	.....	.....
1.0 Lb. Pressure Per Sq. In.—3500 R.P.M.				1.5 Lb. Pressure per Sq. In.—3500 R.P.M.			
600	5	1185	1400	1200	12	1440	1625
1200	8	1535	1745	1800	18	1815	2400
1600	10	1855	.....	2800	27	2685	3090
1700	12	.....	2040	3800	40	3750	4185
2800	18	2135	2715	6200	58	4300	5425
4200	27	2420	2935	9500	85	5170	5910
6000	40	3715	4030	13000	120	6275	.....
8500	58	4535	5335	18000	170	.....	.....
13000	85	5940	6660	.....	.....	.....	.....
17000	120	8150	.....	.....	.....	.....	.....

paid to their leveling and alignment in all directions. Taper bearings or taper wedges allow adjustment for journal wear. Adjustment should be made while the machine is running. The sound of the blower at once indicates the character of adjustment. The blower either should be housed in a place free from foundry dust, or, other precautions taken to prevent the entry of dust into the mechanism.

Delivery of air at pressures of from 1 to 2 pounds per square inch constitutes heavy duty for single stage fans, and for this reason centrifugal fans are designed carefully with a large number of vanes and a carefully shaped casing or scroll. Typical example of a single stage fan, coupled to an alternating current motor for cupola blowing purposes, is illustrated in Fig. 106. All fans run at high speeds, and for that reason sudden jerks in stopping and starting are undesirable. They may upset the balance of the motor by distortion of the weaker parts under the shock. A direct driven fan is desirable for this reason. At high pressures, fans consume more power than blowers for the same quantity of air moved.

In the centrifugal fan, the air drawn in at the center of the eye of the motor, illustrated in Fig. 106, is entrained by the specially shaped entrance buckets of the rotor, mounted on and rotated by the extended motor shaft. The entrained air is led through specially shaped impeller passages from which it is discharged into the stationary scroll shaped casing specially designed to slow down the velocity acquired by the air leaving the tips of the impeller and converting the velocity energy into pressure energy. Standard ratings of fans of this design are included in Table XXI from 0.75 pound to 2.0 pounds per square inch pressure. Characteristic curves in Fig. 107 indicate actual performance of these fans over a wide range of deliveries. Table XVIII is of additional interest in giving the

Table XXIII

Table of Outputs of Cupola Fans

Diam. of Fan W. G. ins.	20-inch Volume	20-inch R.P.M.	20-inch B.H.P.	25-inch Volume	25-inch R.P.M.	25-inch B.H.P.	30-inch Volume	30-inch R.P.M.	30-inch B.H.P.	35-inch Volume	35-inch R.P.M.	35-inch B.H.P.
6	700	1400	1¼	1270	1110	2¼	1980	925	3½	2830	800	5
8	820	1600	2	1470	1280	3½	2280	1070	5¼	3260	920	7½
10	910	1800	2¾	1640	1430	4¾	2550	1200	7½	3650	1020	10¾
12	1000	1970	3½	1800	1570	6¼	2800	1310	9¾	4000	1120	14
14	1080	2130	4½	1940	1700	8	3020	1410	12½	4300	1210	17½
16	1160	2280	5½	2080	1810	9¾	3230	1510	15	4600	1300	21½
18	1230	2420	6½	2200	1920	11½	3430	1600	18	4900	1370	26
20	1300	2550	7½	2320	2030	13½	3620	1690	21	5160	1450	30
22	1360	2670	8¾	2440	2120	15¾	3800	1780	24½	5400	1520	35
24	1420	2780	10	2540	2220	18	3960	1850	27½	5650	1590	39½
26	1470	2900	11¼	2650	2310	20	4120	1930	31½	5900	1650	45
28	1530	3000	12½	2750	2400	22½	4280	2000	35	6100	1710	50
30	1580	3120	14	2850	2480	25	4420	2070	38½	6340	1770	56

Table XXII

Diameters of Pipes for Various Lengths of Air Mains

Length of Pipe 30 FT.	60 FT.	90 Ft.	120 Ft.	150 Ft.	180 Ft.	210 Ft.	240 Ft.	270 Ft.	300 Ft.
Diameter of Blower Outlet	Diameter of Pipe Should Be								
3 ..... 3¼	3⅝	4	4¼	4½	4¾	5	5⅛	5⅜	5½
3½ 3¾	4⅛	4½	4⅞	5	5¼	5½	5⅝	5⅞	6⅛
4 ..... 4⅜	4¾	5⅛	5⅜	5¾	6	6¼	6½	6¾	7
4½ 5	5⅜	5¾	6	6⅜	6¾	7	7¼	7½	7⅞
5 ..... 5½	6	6⅜	6¾	7¼	7½	7¾	8⅛	8⅜	8¾
6 ..... 6½	7	7⅝	8	8½	9	9⅜	9⅝	10⅛	10½
7 ..... 7⅝	8¼	8⅞	9⅜	10	10⅜	10⅞	11⅜	11⅝	12¼
8 ..... 8¾	9½	10¼	10¾	11⅜	11⅞	12⅜	12⅞	13⅜	13⅞
9 10	10⅜	11½	12⅛	12¾	13⅜	14	14½	15⅛	15⅝
10 11	11⅞	12¾	13½	14¼	14⅞	15½	16⅛	16¾	17⅜
11 12	13	13⅞	14¾	15⅝	16⅜	17⅛	17¾	18½	19⅛
12 ..... 13⅛	14¼	15¼	16⅛	17	17⅞	18⅝	19⅜	20⅛	20⅞
13 ..... 14¼	15⅜	16½	17½	18⅝	19¼	20⅛	21	21⅞	22⅝
14 ..... 15⅜	16⅝	17¾	18⅞	19¾	20⅜	21⅜	22⅝	23½	24¼
15 ..... 16½	17⅞	19	20⅛	21¼	22¼	23¼	24¼	25⅛	26
16 ..... 17½	19	20⅜	21½	22⅝	23¾	24¾	25⅞	26⅞	27⅝
17 ..... 17⅝	20⅛	21½	22⅝	24	25¼	26⅜	27½	28½	29½
18 ..... 19¾	21⅜	22¾	24¼	25½	26¾	27⅞	29⅛	30⅛	31¼
19 ..... 20⅞	22½	24	25½	27	28¼	29½	30¾	31⅞	33
20 22	23⅝	25⅜	27⅛	28⅜	29¾	31	32¼	33½	34¾
21 23	24⅞	26⅝	28¼	29⅝	31¼	32½	33⅞	35¼	36⅝
22 ..... 24⅛	26⅛	27⅞	29½	31⅛	32⅝	34⅛	35½	36⅞	38⅛
23 ..... 25¼	27¼	29⅛	30⅞	32½	34¼	35⅝	37¼	38½	39⅞
24 ..... 26½	28½	30⅜	32¼	34	35⅝	37¼	38¾	40¼	41⅝

rated outputs of another blower related to the diameter and output of the cupola.

Fans usually are driven by alternating current motors, but where control over the delivered volume is needed direct current and a variable speed motor are required. Usually with an increase in speed and power an increase of 33 1/3 per cent over the rated delivery capacities of the fans may be obtained.

The distribution main leading from the blower to the cupola should be as straight as possible. All sharp bends should be avoided and where other bends are necessary, they should take an easy curve. The pipe should have a larger diameter than the blower outlet. Usual recommendation for a short length is 25 per cent and for a long length 50 per cent larger. Table XXII indicates necessary increase in blast pipe diameter with increased length.

In cupola economy, quantity, weight or volume of air delivery is just as important as the quantity of fuel, the other participant in the combustion reaction which provides necessary heat for melting the iron. Consequently, measurement of air becomes a factor of considerable importance in the scientific control of the cupola. Where a positive pressure blower is in use the quantity of air can be determined from the number of blower revolutions. A simple pressure gage or a relief valve set to open at a definite pressure at once indicates undue resistance to the passage of the air. With fan blowers the quantity of flowing air can be determined only with reasonable accuracy by some form of measuring instrument.

Measurement of direct or static pressure of the blast is comparatively simple. No elaborate instruments are necessary. The simplest form of instrument for this purpose, the liquid manometer, is a glass U-tube containing a suitable liquid, water, carbon tetra-chloride or mercury. Both members of the tube are marked with a graduated scale to show inches of water or ounces or pounds per square inch. One end of the manometer tube is connected to the air supply, and the other remains open to the atmosphere. Difference in level of the liquid in the two limbs of the manometer is produced by blast pressure. For purpose of comparison the factors shown in Table XX will be found useful.

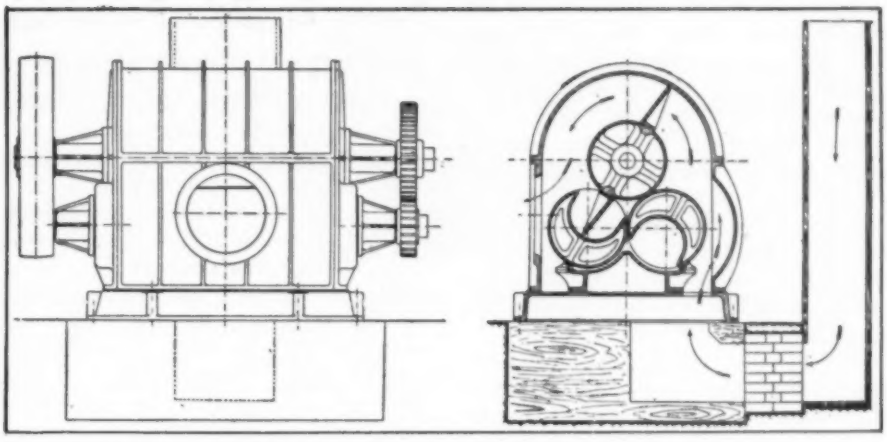


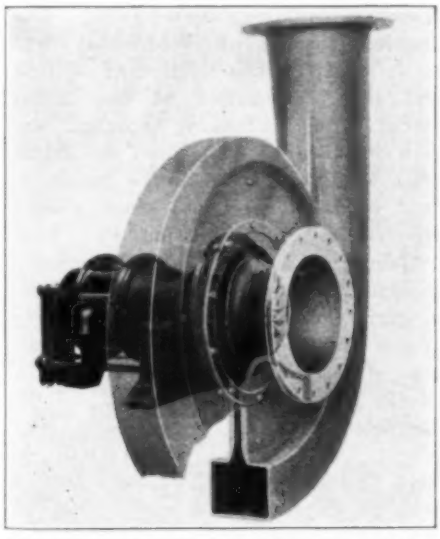
FIG. 105—BAKER TYPE POSITIVE PRESSURE BLOWER FOR CUPOLA

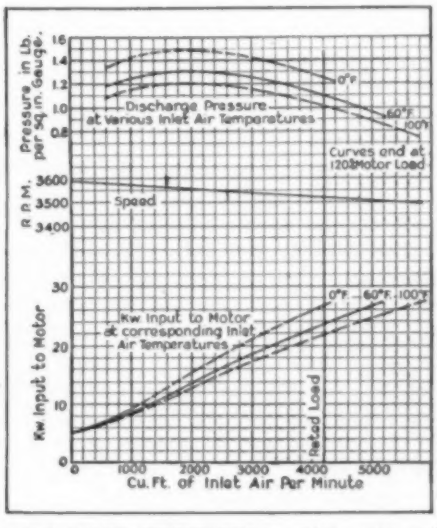
Equipment Saves Time

(*Continued from Page* 321)

in each cylinder mold. The sand is rammed in metal coreboxes and the corebox is taken apart to leave the almost square block of sand sitting on the core plate, with the two barrel cores standing above it. A tapered, perforated steel tube in the center of each barrel forms the only reinforcement in these cores. The only reason for tapering the tube is that it readily may be knocked out of the sand after the casting has been poured. While still in the green state a metal cap is placed over the top of the two barrel cores to hold them accurately in position. This cap rests on the ends of the steel tubes.

These combination body and barrel cores are loaded on cars operating on a length of narrow gage track extending along one side of a battery of three ovens made by the Foundry Equipment Co., Cleveland. One oven opens to the south. The remaining two open to the north. A turntable in the track on the south side facilitates the entrance of the loaded cars and the removal of the cars carrying the dried cores. On the north side the tracks are straight and the ovens are used alternately. The ovens are fired with coke from a common firebox at one end. Suitable chambers under the floor distribute the heat to the three ovens. Temperature is regulated by dampers placed in the flues and is under pyrometric control.





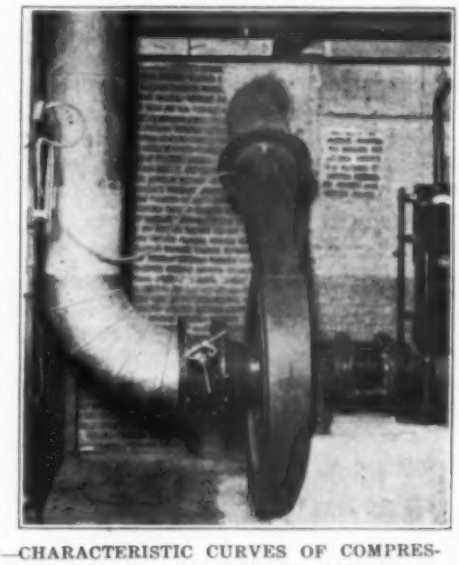


FIG. 106—PHANTOM VIEW SINGLE STAGE, SINGLE INLET CENTRIFUGAL FAN. FIG. 107—CHARACTERISTIC CURVES OF COMPRESSOR RATED AT 4200 CUBIC FEET PER MINUTE. FIG. 108—SINGLE STAGE CUPOLA FAN DRIVEN BY 27-HORSEPOWER MOTOR AT 3600 REVOLUTIONS PER MINUTE

Extent to which standardization and simplification have been introduced into the core making department is exemplified typically in a device for blacking part of the body and barrel cores. The core is placed upon a small platform supported at an angle of 30 degrees above a tank filled with blacking. The operator pulls a lever and the platform is submerged to a point that will cover the flat face of the core and the drag side of the barrel cores with blacking.

The mold is poured through a number of small, thin gates at the bottom edge of the crankcase and the lower part of the core is blacked to insure a clean surface on the casting where the hottest metal first comes in contact with the sand. By the time the metal has started to climb over the barrel cores, the temperature has been reduced to a point where the sand is sufficiently refractory to insure a clean surface without applying any auxiliary coating.

Castings are cleaned in a battery of four large rectangular tumbling barrels made by the W. W. Sly Mfg. Co., Cleveland, and in seven cylindrical barrels made by the R. McDougal Co. Ltd., Galt, Ont. The cylinder block castings are picked up on the outside of the building where they have cooled. They are suspended from hooks hanging from a monorail and taken in to the tumbling barrels. After a period of tumbling they are sandblasted on a rotary table made by the W. W. Sly Mfg. Co., Cleveland. The rotary table receives the castings on the side next to the tumbling barrels and discharges them into a room where they are chipped and ground and otherwise prepared for shipment.

A belt line railroad connects the plant with all the main lines and thus facilitates the importation of the great volume of raw materials required to keep a plant of this capacity operating. Most of the castings are shipped by truck to the Ford plant about 5 miles distant.

Compressed air for operating the molding machines, hoists and pneumatic tools in the chipping department, is supplied by two compressors, one supplied by the Ingersoll-Rand Co., New York; the other by the Bury Compressor Co., Erie, Pa. Electric current is taken from a supply generated at Niagara Falls and distributed all through the province of Ontario by a governmental body known as the Ontario Hydro-Electric Power commission.

The Carborundum Co., Niagara Falls, N. Y., opened the new Carborundum building, 2759 East Grand boulevard, Detroit, recently.

Nine English Foundries Form Corporation

A corporation has been formed by nine English foundries called Associated Foundries Ltd. with a probable total capital of $15,000,000. This merger is the result of a provisional agreement between the Sinclair Iron Co. Ltd. manufacturers of rain-water goods and builders' light castings, and the Austin Friars Trust Ltd. for the formation of a company to acquire the shares of the Sinclair Iron Co. Ltd. and eight other firms in the light castings trade. These firms are: Abbots Foundry Co. Ltd., Falkirk, makers of ranges, stoves, grates and light castings; Burton Foundry Co. Ltd., Burton-on-Trent, makers of ranges, fireplaces and stoves; Callendar Iron Co. Ltd., Falkirk, manufacturers of light castings; J. Clay (Wellington) Ltd., Ketley, Wellington, makers of light castings and agricultural engineers; R. W. Crosthwaite Ltd., Thornaby-on-Tees, manufacturers of light castings and cast iron pipes; The Falkirk Iron Co. Ltd., Falkirk, stove and general iron founders; Forth & Clyde & Sunnyside Iron Companies Ltd., Falkirk, makers of ranges, stoves and architectural ironwork, and Light Castings Ltd., Audenhaw.

Blast Furnace Operation Affects Quality

(*Concluded from Page* 325)

bustibility curves of these two cokes given in curves 3 and 4, Fig. 2. Although the ignition temperature of coke 4 is 150 degrees Fahr. higher than that of coke 3, the burning rate is similar.

By blowing air faster into furnace *C* the rate of burden travel could probably have been increased to equal that in furnace *D*. On the other hand, in the case of heat 9 from furnace *E*, air is supplied at a faster rate than in the case of heat 6 from furnace *C*. There were 516 pounds per hour per square foot cross-section as against 443, but the quality of coke used for heat 9 was such that the air could not be used as fast as it was supplied. Only 92.7 pounds coke per hour per square foot were burned as against 111.0 in furnace *C* in spite of a greater amount of air being supplied to furnace *E*. This results in excessive air being supplied per pound of coke burnt in furnace *E*. There were 6.3 pounds of air per pound of carbon as against 4.27 in furnace *C*.

The slow rate of coke combustion is, of course, responsible for the slower burden travel and also for the larger amount of air supplied per pound of iron produced. In heat 8 made in *E* furnace 5.45 pounds of air were used for every pound of iron produced while in heat 6 made in *C* furnace, only 3.29 pounds of air were used per pound of iron produced. This air combines with carbon in a small region right in front of the tuyeres.

According to Kinney, bureau of mines bulletin, "Study of the Reaction in Air Iron Blast Furnace," there is a sort of laterally flattened sphere some 30 to 36 inches in diameter, measured on the tuyere axis in front of each tuyere where there is free oxygen and excessive CO, so that oxidation of the iron can take place. In the case where greater quantities of air are blown in uniting with the oxygen, this sphere will be larger in extent and contain more free oxygen.

Presents Carnegie Medal for Research

The council of the British Iron and Steel institute has decided to present the Carnegie gold medal of the Iron and Steel institute to Dr. Arthur Bramley, head of the metallurgical department of Loughborough college. The medal, which was founded by the late Andrew Carnegie, is awarded to the research worker who, in the opinion of the council, has produced the most meritorious piece of research work each year under the scheme of the Andrew Carnegie research scholarships of the institute.

Welders Plan Meeting

Many important technical papers are listed on the tentative program for the annual meeting of the American Welding society, to be held April 24, 25 and 26 at the Engineering Society's building, New York. The opening session on Wednesday will be followed by the election of officers and the presentation of the Miller medal. The Wednesday technical session includes a symposium on industrial welding schools and a paper on butt welds by G. Lobo, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The Thursday session includes papers by A. Vogel, General Electric Co., Schenectady, N. Y., Professor S. E. Dibble, Carnegie Institute of Technology, Pittsburgh; R. M. Mock, Bellanca Aircraft Corp., J. H. Deppeler, Metal & Thermit Corp., New York. The annual dinner will be held Thursday night. Friday's session will be devoted to a symposium on welding in the chemical and process industries and to the annual meeting of the American bureau of welding.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Mixtures for Soil Pipe

QUESTION

What is the best kind of iron for soil pipe castings, also the best kind of coke for use with this iron in the cupola? How much coke is required per ton of iron?

ANSWER

Soil pipe castings are not subject to severe service. Therefore, practically any mixture of ordinary foundry iron may be employed to pour them. The only requisite is that in the molten condition it shall be extremely fluid. The mold and core are made entirely in green sand. The metal thickness varies from ¼ to ⅜-inch and the usual length is 5 feet 6 inches. Sizes range from 2 to 8 inches diameter.

The usual analysis of iron poured in soil pipe molds is: Silicon 2.50 per cent, sulphur 0.10 per cent, manganese 0.60 per cent, phosphorus 0.60 per cent, total carbon not less than 3.50 per cent. The amount of these various elements may vary to a considerable extent without affecting the quality of the product.

The iron mixture really is a market problem rather than a technical one. Usually the mixture is made up of half and half pig iron and scrap, but if an exceptionally good grade of scrap is available, the amount in the mixture may be increased to any reasonable extent. Hard scrap or scrap that has been burned should be avoided. Its *life* is gone and it will prevent the iron from running freely in the mold.

Any grade of coke may be employed to melt the iron. A cheap grade may be employed satisfactorily for short heats, but if long heats are contemplated it will be necessary to employ a high grade coke running approximately 90 per cent fixed carbon and correspondingly low ash. Coke with a high ash content will choke the cupola in a short time. Like the iron, the selection of a proper grade of coke is a market and not an operating problem. The amount of coke required per ton of iron will depend on how efficiently the cupola is operated. On account of the extremely high temperature at which the metal must be melted to run steadily it will be well to melt a ton of iron with 250 pounds of coke, a ratio of 1 to 8.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorials staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Steel Casting
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Foundry, Penton Building, Cleveland.

Q & A

Piano Frames Crack

QUESTION

What is the best mixture for manufacturing piano frames? At present we are using a mixture of 50 per cent pig iron and 50 per cent No. 1 scrap, but the results are not as desired. A number of these frames have cracked during the construction of the piano, and some while being tuned.

ANSWER

Piano frame castings should be made of metal which is strong but comparatively soft. For this reason the silicon should range from 2.20 to 2.50 per cent and the phosphorus from 0.40 to 0.50 per cent. Sulphur should be held under 0.10 per cent and the manganese should be approximately 0.60 per cent.

The cause of cracks in your castings is difficult to determine since you do not state where the cracks appear, or the analysis of your present mixture. We believe that the phosphorus and sulphur are too high, as these constituents tend to produce brittleness. We also advise that you use no foreign scrap, but only that from your own shop. The molds should be well gated, and have from five to seven pouring gates with one riser near the center. Uncovering the center of the mold shortly after it is poured will prevent warping.

Your attention is directed also to an article on piano plate castings published in THE FOUNDRY, June 1, 1920.

Q & A

Low Phosphorus Needed

QUESTION

On page 195 of the March 1 issue under the heading, Phosphorus Is Too High, the reason for a faulty casting is attributed to high phosphorus. In the same issue on page 199 under the heading, Gives Experience with High Phosphorus Iron, excellent results with high phosphorus iron are obtained. Since the two seem diametrically opposed I should like to have your comment in reconciling the two statements.

ANSWER

The anomaly in the March issue is much more apparent than real. The salient factors relating to the presence of phosphorus in cast iron are that steadite, the phosphorus rich component, is one of the major structural components of gray iron; that is to say graphite, ferrite, pearlite, steadite. In round figures the composition of steadite usually approaches 10 per cent phosphorus and 90 per cent iron. As its specific gravity is close to that of the remainder of the metal, 1 per cent phosphorus would give approximately 10 per cent steadite by volume. Steadite is hard and abrasion resistant. It is quite brittle, but strong. MacKenzie

has shown (*Trans.* A.F.A. and *Proc.* A.S.T.M.) that at intermediate loads phosphorus does not lower the deflection—which he says depends on the ratio $C + \frac{Si}{4}$, or his later ratio $C + \frac{Si}{3}$.

In discussion of these papers Bolton has proved that the ultimate deflection is lowered with increase in phosphorus. The consensus of opinions is that phosphorus in itself lowers strength slightly, but greatly decreases shock resistance. Steadite is fluid, solidifying at about 1800 degrees Fahr.—long after the rest of the metal has set (2050 degrees Fahr. and above). Therefore, steadite has some influence on fluidity and lengthens the solidification period of the metal—matters which often give rise to nasty shrinkage problems. Further, it is apparent that under certain cooling conditions steadite is likely to be found at the grain boundaries, giving rise to the common *network* formation. Wuest has shown (and his work has been confirmed by MacKenzie) that the higher the percentage of phosphorus, the lower the percentage of total carbon, other conditions remaining the same.

MacKenzie and Bolton have proved that the steadite in gray iron is a binary eutectic, hence substantially carbon free. Thus it may be seen, that in ordinary pig iron, tending toward the eutectic equilibrium when carbon + 0.3 silicon = 4.2 per cent at 2050 degrees Fahr., the *volume* of steadite present cuts down the amount of the other components of the metal. Hence, the lowering in carbon is a phenomenon logically to be expected.

In the article on page 195 of the March issue the phosphorus is too high for pressure resisting castings, just as presented. They tend toward drawholes unless carefully fed with heavier risers—hence porosity. Further, the foundry in question is making castings for pressure resistant parts where the low shock resistance of higher phosphorus is undesirable. For such work 0.20-0.35 per cent phosphorus is preferable and fluidity is obtained by good cupola practice.

English blast furnace irons are low carbon—containing around 3.30 per cent. When the foundryman used this iron he at first ran into shrinkage—*not* porous metal due to *open grain* graphite. Yet the metal in England made into cylinders did well in service—since the hard steadite resists abrasive wear on the bore by the rings. One large automobile firm using a V-8 cylinder block once used high phosphorus to obtain the same type wear resistance, and in sugar mill rolls high phosphorus material (steadite) standing in relief enables the roll to seize the bagasse more readily. In America foundrymen lean toward pearlitic irons for cylinder service, as these have fine uniform grain of excellent wear resistance.

As to machinability experience shows that due to the somewhat different distribution, high phosphorus is not nearly as detrimental in large as in small castings—particularly small castings of rather high strength irons. In any case the foundryman's practice is determined by the service for which he sells his castings plus the materials he has available to make them with. The finest irons, the strongest irons, the most machinable irons, the best wearing irons, today, here and abroad are confined as a rule to lower phosphorus material—always providing this is available. However, this does not say that fairly good metal for certain service, under certain foundry conditions cannot be made from higher phosphorus—and a review of the second paragraph shows the why and wherefore lying back of the practical question.

MALLEABLE

Chills Drive Shrinkage

QUESTION

Have you any data on the comparative resistance to pressure, either air or liquid, of red brass and malleable cast iron? Recently a customer told me that most malleable makers at present are using few chills and have replaced these with shrinkers. He also stated that chills only drove the shrinkage to another part of the casting. It is the first time that I ever heard this assertion made and I would like to have it verified. The way the customer wants the patterns gated will require more metal for shrinkers than the casting.

ANSWER

Your informant who stated that chills drive the shrinkage to other parts of the casting is right. H. A. Schwartz in his book, *American Malleable Cast Iron*, states on page 244, "By accelerating freezing they (chills) suppress the shrink in their immediate vicinity. However, since the reduction in volume still exists, an equal volume of shrinkage will develop elsewhere.—Continuously supplying molten iron until the entire casting is frozen is the only actual preventive of shrinks."

"The shrink always is found in the slowest freezing locality. Therefore if a feeder of still slower cooling rate, attached to the pattern, is located that the metal can flow from it to the location in which the shrink was found, then the shrink will be transferred to this feeder and be of no consequence, since the feeder (shrink bob) is not a part of the finished product."

We have no data at present on the comparative resistance to pressure of brass and malleable. However, we would like to have more information as to the type of service such as pressure, type of liquid or gas, temperature, etc., that the castings will have to withstand. From this data we may be able to give definite information.

Q & A

Hard Scale Forms

QUESTION

Have there been any recent developments in eliminating scale resulting from annealing in muffle type ovens? We are positive that there are no leaks in the muffle chamber and all oxygen is burned out with a fire before heat is applied. We heat our castings without packing, and our schedule of anneal is as follows: 36 to 48 hours from time of starting fire to time of critical heat, 1525 to 1550 degrees Fahr.; 60 to 65 hours at 1525 to 1550 degrees; 36 hours dropping to 1350 degrees; hold 24 hours at 1350 degrees; 60 to 72 hours dropping from 1350 to 850 degrees; oven opened at 850 degrees.

ANSWER

We believe that the reason for scale lies in the temperature that you open the furnace. At a temperature of 850 degrees Fahr. the castings will be a faint red, and castings in this condition will oxidize readily. The scaling may not be as pronounced as that occurring at higher temperatures, but it will be plainly in evidence.

We believe that the temperature should be dropped down to 500 or 600 degrees Fahr. to prevent an occurrence of scale, although you can determine by experiment the highest temperature you may remove the castings without scaling.

It seems to us that your first holding temperature is lower than that generally used in most malleable anneals. Usually this temperature ranges from 1600 to 1650 degrees Fahr. The time to reach your temperature of 1525 to 1550 seems long, but may be due to the type of furnace. The ordinary malleable pot-annealing furnace will reach 1600 degrees in about 30 hours.

Your first holding time is about right as most plants allow about 60 hours. Your critical holding temperature 1350 degrees Fahr. is about right as this is estimated to lie between 1340

to 1375 degrees. Most malleable annealers allow the temperature to drop from the high to critical at the rate of from 4 to 10 degrees per hour. Your average rate is about 5½ degrees per hour and checks rather well with the usual practice.

After the castings are held at the critical temperature the temperature is dropped slowly to about 100 degrees under this point and then the furnace cooled rapidly as possible as nothing is gained by additional slow cooling. In the pot type furnace the doors are opened and the pots stand in the furnace until the temperature is such that the men can go in with trucks and remove the pots. However, with your muffle type furnace you cannot do this as your castings should not be admitted to the air until they have dropped to a temperature at which they will not be subject to oxidation or scaling. Therefore we suggest that you open your firedoors and stack dampers to give a free circulation of air around the muffle to hasten the temperature reduction as much as possible.

We assume that you have your furnace sealed, that is the firebox, etc., when the temperature is dropping down to 850 degrees as the rate of temperature reduction is only 7 to 8 degrees per hour. As stated previously, no advantage is gained by slow cooling after dropping slightly below the critical point of 1350 degrees. Therefore, you can gain considerable time in your annealing cycle even though you have to allow the castings to reach a lower temperature before removing to the air.

STEEL

Steel Is Inferred

QUESTION

One of our customers has ordered a crusher plate to be made from *carbon alloy*. We are not familiar with this term and will appreciate your advice on how to prepare the metal for this casting in our gray iron foundry.

ANSWER

The term *carbon alloy* is new to us. It would seem to suggest that the customer wants a steel and not an iron casting. Crusher plates are made from alloy steel (usually manganese) from plain carbon steel and from hard iron. Without a knowledge of the size and shape of the crusher plate you have in contemplation, it is impossible to suggest a suitable composition for an iron plate. Some crusher plates are subject only to abrasion, while others have to withstand shock and torsional strain. Obviously the composition of the plates must vary to meet these particular requirements. The following analysis for a rock crusher plate 18 x 24 inches and 4 inches thick may serve as a guide: Silicon 0.80 per cent, sulphur 0.05 per cent, phosphorus 0.20 per cent, manganese 1.00 per cent, total carbon 3.25 per cent. The working face of this casting is chilled to a depth of approximately 1 inch.

Q & A

Needs Refractory Sand

QUESTION

On account of the high cost of steel molding sand in this district I should like to know what kind of an old sand mixture I can make up to produce a first class steel casting.

ANSWER

If by old sand mixture you mean the heap sand usually employed in an iron foundry, then the answer is we do not know of any such mixture that will make a mold for a first class steel casting. Practically all the sand used in gray iron foundries contains a considerable amount of bonding material and this bonding material reduces the refractoriness of the sand to such an extent that the heat from the molten steel melts it and fuses it to the face of the casting. The result is an unsightly, scabby, rough and dirty lump of metal instead of a nice clean, smooth replica of the pattern. Naturally small, light castings do not impose the severe burden of large castings on the refractoriness of the sand. For that reason heap sand is mixed freely with the new sand in facing for the small castings, while new sand exclusively is used for facing on the heavy castings. However, even the old sand originally was of a highly refractory species and not of the kind usually employed in gray iron or brass foundries.

The ideal sand runs from 95 to 98 per cent silica, but sand with a silica content of 90 or a little less will make satisfactory facing. Rounded grains are preferable to any other shape since they assure maximum permeability.

Q & A

Facing Sand Is Mixed

QUESTION

Kindly send me information on the subject of sand mixtures and bonding materials used in the molding of light and medium weight steel castings. Also what is the best material to make them peel freely?

ANSWER

Sand used for molding any kind of castings is composed of silica grains bonded with clay. The only difference between the sand used for steel molding and that used for any other metal, with the exception of monel metal, is that on account of the high silica content required, the former must be prepared artificially, while satisfactory sand for molding castings in other metals is found practically in all parts of the country, ready mixed in a natural state. The mixtures of course vary considerably in detail, mainly in the relative proportions of silica and bond content.

Pure silica sand practically is the only material that will not fuse in a mold exposed to molten steel. However, pure silica sand has no bond, therefore it cannot be packed or rammed into a definite shape. Before it can be used to form a mold it must be mixed with some agent that will hold the sand grains together with the least loss of refractory quality. The most convenient material for this purpose is some form of fire clay. For light steel castings about two shovelfuls of silica sand added to a wheelbarrow of a good open grain molding sand will work satisfactory. As the weight of the castings increase the relative proportions of silica sand and molding sand changes until it reaches a point where the mixture practically is all silica sand with a small amount of clay. The only satisfactory method for mixing steel foundry facing, or for that matter any kind of facing, is in a mechanical mixer. Finely ground silica flour is dusted on the face of green sand molds. The same material mixed with some form of liquid core binder is applied as a wash to dry sand and skin dried molds.

GENERAL

Fluxes for the Cupola

QUESTION

Can you advise me on what is the best flux to use with limestone to make the slag more fluid? Do you believe that caustic soda with a certain amount of limestone will make a fluid slag?

ANSWER

As a general rule about 3 per cent of the iron charge is the base for the limestone put on the charge. In other words, a 2000-pound iron charge would require 60 pounds of limestone. Ordinarily the slag should be fluid enough to be tapped out easily, but not always. Many foundries have used fluorspar to make the slag fluid and it has been found excellent for that purpose. It also is claimed to act as a desulphurizer, but there seems to be considerable controversy on this point. However, it is quite

corrosive on cupola linings and must be used with care. In cupolas with a 2000-pound iron charge, where the scrap carried considerable sand, 45 pounds of limestone and 15 pounds of fluorspar were used. This gave a fluid slag which was run continuously from the cupola during an 8-hour heat which was regular practice.

Fused soda ash in brick form, such as sold by advertisers in THE FOUNDRY, under a trade name also is said to give a fluid slag. According to the manufacturers, it also has excellent desulphurizing powers. As far as I am aware, caustic soda never is used because it is dangerous material to handle in that it is so caustic. It will cause bad burns on the skin with which it comes in contact. Also it will absorb water from the air and become sticky and wet.

Another point to keep in mind is that your slag should not be too fluid as it may cause considerable trouble in trying to remove it from the ladle. If the slag is extremely fluid, it hardly can be removed, and will be carried into the mold to form defects in the casting.

Q & A

Galvanizes Hollow Ware

QUESTION

We desire to galvanize small cast iron hollow ware pots like the enclosed illustration by the dip process. Have you any information on how it may be accomplished?

ANSWER

The sketch which you mention in your letter was not enclosed, but we believe that we can give you the necessary information without it. It is assumed that you want to galvanize the pots both inside and outside and we will describe the process on that basis. First of all, the pots must be perfectly clean. If they are not, it will be useless to try to galvanize because the zinc will not stick or coat evenly and uniformly.

The castings should be cleaned preferably by a sandblast machine, but if this is not available, any other method that will give a clean job will do. The castings then are pickled in an alkali solution containing 38 pounds of lye per 100 gallons of water. This will remove any grease, graphite to some extent, and rosin if that type of core is used. The solution should be hot and the articles left in the bath from 5 to 10 minutes. The castings are removed, washed in hot water and allowed to drain.

After the alkali bath and washing, the castings are given a muriatic acid bath. This bath consists of one-half muriatic acid and one-half water by volume. The castings are allowed to drain, and then placed in a dryer until thoroughly dry. The temperature should not be as high as to burn off the acid coat which appears as a white powder on the surface. After they are dry the castings are ready for galvanizing. An iron pot of a size large enough to permit the work to be dipped in, generally is used to hold the molten zinc. This is supported properly to relieve any strains on the pot, and heated by gas or other fuel which will give an even temperature. After the zinc is molten, the temperature should be maintained at 850-860 degrees Fahr. Pyrometric control is advisable.

The surface of the molten zinc is covered by a layer of sal ammoniac to prevent oxidation and to act as a flux. A few drops of glycerine put on the fluid flux will hold it together. When a casting is to be dipped, push the flux to one side and leave a clear space for dipping. Use a good pair of tongs to handle the work, and move casting gently in the bath to make sure that the molten zinc touches all parts of the surface. Raise the casting from the bath, and grasp it with another pair of tongs in such a manner that the molten zinc will run toward one place on the casting. Allow the excess to drain off and as the drop just begins to harden remove it with a stiff brush or old file. When crystals appear on the surface, brush it lightly with a brush wet with clear water.

Q & A

Wants to Specialize

QUESTION

I would like to know the status of the foundry chemist and if it would be a profitable field of endeavor. Also, what is the status of foundry cost accounting, and what is the opportunity for accountants of this nature? I am a bookkeeper and a student of chemistry and have been employed by a foundry for several years. I am planning to specialize in some branch of the industry and perhaps you can assist me in directing my endeavors to a sound channel. Are there any schools specializing in the previously mentioned subjects?

ANSWER

Many of the larger foundries employ metallurgists and chemists, but the smaller foundries feel that positions of this type add too much to overhead without any direct return. However, it is suggested that if you wish to enter this field that you study the broader line of metallurgy rather than just chemistry. Metallurgy deals with studies of the properties of metals and their manufacture, while chemistry usually deals with analyses, etc.

Also it is suggested that if possible, you should obtain a degree in your chosen field from some college or university. This advice is the result of experience of a practical chemist and metallurgist, who found that usually a man with the college degree, after he had gained a little experience, was paid better and advanced quicker. Consequently, he embarked on a college career, and found that the returns amply justified the time and money spent for education.

Another factor that will be of the greatest assistance should you decide to enter this field, is to learn all you possibly can about the practical end of the foundry such as molding, cupola operation, core making, etc. The best way to obtain a good foundation in these phases is to get into the foundry and do the work yourself. By knowing the practical end and having a knowledge of the theoretical aspects, you will be able to advance much farther.

Foundry cost accounting still seems to be in its infancy because foundrymen seem to be loath in knowing the exact costs of the castings they make. Of course, the larger and more modern foundries check their costs closely, but the majority of foundries are small and figure their costs by guesswork. This is one of the reasons for price cutting as each one figures that he can undercut the other's price, on the theory that if the other can make a profit at 3 cents a pound, he can shade it a trifle and make money. However, the first guessed at his cost and was losing money, and the other was worse off still.

At the present time there is much agitation on the subject of costs. Technical and trade journals in the foundry field are publishing many articles dealing with this phase pointing out the importance of costs. Consequently, more attention is being paid to this subject. However, as in the case of a metallurgical department, small foundries feel that a costing department would cost more than they could get out of it. It might be possible that you could develop a simple system which you could install in a number of these small foundries on a fee basis.

Many schools have adequate courses in metallurgy and accounting. A list to include them would take considerable space, so it is suggested that you go to the dean of men or the president of the college which is located in your city and lay your problem before him. Either will be glad to give you advice on the subject.

How and Why in Brass Founding

By Charles Vickers

Suggests Tablet Mixture

It is our intention to engage in the making of bronze plates, such as are used in marking buildings, memorials, etc., largely as an accommodation to certain of our regular customers. As this is a new venture for us we will appreciate suggestions as to the best facing and metal mixture.

In reply to this query we can do no better than quote from a paper presented at the annual convention in 1923 of the American Foundrymen's association by the late Jacob G. Kasjens as follows: "Any good sand suitable for other fine brass work can be used for making tablets. It should be prepared the day before it is used. First, put it through a No. 10 seive adding about one part of dextrin core compound to every 40 parts of the sand. Seive the mixed sand and core compound, then damp it for molding and then screen again through a No. 4 seive this time. Cover the heap with well dampened gunnysacks and alloy it to stand overnight to mellow." This will give a strong facing sand that will require no brads to secure the small ridges of sand between the lettering. Care has to be exercised when ramming the face of the pattern and Kasjens suggests this be done by screening the sand from a height of 12 feet on the pattern until a considerable thickness has been built up. After the mold is made it will be advisable to spray the impression with molasses water, and afterward skin dry which is usually done with a gas or a gasoline torch. A suitable alloy would be: 88.50 per cent copper, 5.50 per cent tin, 3.50 per cent zinc and 2.50 per cent lead.

To Make Hard Aluminum

We have been experimenting recently with ferrochromium and find it hard to melt into an aluminum hardener. Can you give us instructions for doing this? We want an aluminum alloy with a brinell hardness number of 180.

We doubt whether ferrochromium would be at all helpful in alloy with aluminum, even if it could be alloyed without difficulty. While it is a hard and refractory metal it does not follow that its effect on aluminum would be to give great hardness and so produce an alloy with a brinell of 180, nearly four times that of No. 12 aluminum alloy. When aluminum and ferrochromium are heated together the aluminum fails to dissolve the ferroalloy. It does not wash it down like many other metals, nickel for instance. To make such a rich alloy it will be necessary to apply sufficient heat to melt the ferrochromium first, then add the aluminum gradually to the molten mass. We understand that alloys of chromium and aluminum are sold, therefore, the better way would be to secure a quantity of the alloy and add the iron as desired. In experiments made by editors of THE FOUNDRY, ferrochromium was dissolved in aluminum by an aluminothermic reaction, but this is not recommended. The hardener so produced was of no value as an addition to aluminum. We doubt if an aluminum alloy of 180 brinell can be made, but we always are pleased to learn. For that degree of hardness we think that it will be necessary to use copper base alloys, with which a brinell of 180 is not difficult to obtain.

Hard Cores Cause Trouble

In making aluminum castings we experience considerable trouble due to blowing cores. We have been using flour and oil, and have tried a number of other binders without success. We shall be greatly pleased to learn of a suitable binder for this work.

Combinations of flour and oil core binders are quite likely to produce blown castings even with brass. The cores easily become too dense and hard for the metal to lie against them. No doubt it is necessary to use such binders in making round extruded cores where they give satisfaction, but for cores of intricate shape and especially for aluminum, other binders give greater satisfaction.

The foundryman can make his own selection from a wide list of core binders. All are good, and the names and addresses of the manufacturers can be selected from the advertising columns of THE FOUNDRY. The binders are advertised to attract the attention of users, so that they will write and ask questions. Communicate with the corebinder makers and get their sales talks, and by comparing the results of the labor of writing a few letters a suitable selection of a binder can be made. Directions for using the binders will be sent, and possibly it will be found that some person in your vicinity is using the binder you select, mixed with the local sands, and getting fine results.

Wants Acid Dip

We would like to get the formula for an acid dip for our red brass castings. Can you advise us what generally is used?

First, either wash the brass castings in a solution of caustic soda or sandblast them. Then immerse the castings for a moment in a mixture of nitric acid 2 gallons, sulphuric acid 1 gallon with a cupful of salt added to a 20-gallon crock. Remove the pieces and rinse thoroughly in cold water. Then put them into the cyanide crock for a couple seconds to remove all tarnish. This latter solution consists of 1½ pounds of potassium cyanide dissolved in 20 gallons of water. It sometimes is advisable to dip more than once. After the final dipping the articles are rinsed in cold water, then in hot water, and then are dried in sawdust.

Another dip consists of nitric acid, 1 gallon; sulphuric acid, 1 gallon; hydrochloric acid, 2 ounces; water, 1 quart. Clean the castings by immersing in a hot solution of lye. Then rinse and dip for a moment in the mixture of acids just given. Wash after this dip and immerse in a potassium cyanide solution consisting of 2 ounces cyanide to 1 gallon of water. Remove the castings and wash the articles in cold water. Immerse in boiling water, remove and pass through a solution of 2 ounces whale oil soap to the gallon of water. Then dry.

It must be understood the cyanide is an extremely poisonous salt and must be handled with care. Also the solutions containing cyanide partake of the poisonous qualities of the salt, and the dips should be so located that the fumes of the acids are carried away freely so that they cannot be inhaled to any great extent.

Bill Wrestles with an Over Weight Casting

By Pat Dwyer

UTTERLY oblivious to the risk of life and limb incident to such high handed and unwarranted intrusion, a young lady climbed on my knee the other night. I was reading a book at the time, a good hefty book capable of inflicting considerable damage if brought down with sufficient force and speed. While I was debating mentally whether I should apply the edge or the flat, she calmly removed the book from my hand and dropped it to the floor. Purely in self defence I had to curl one arm around her while with the other hand I hastily shifted my pipe about 45 degrees from the extreme southwest to a point east-south-east by east in the arc of my mouth.

"Now that you have succeeded in wrecking the end of a perfect day," I remarked in my deepest and most blood curdling tones, "perhaps you will be kind enough to tell me to what fortuitous chain of circumstances I am indebted for the pleasure of this visit."

"What visit?" she inquired, innocently.

"Why, this one," I replied. "Here you come tearing in like a Kansas cyclone, throwing books right and left—"

"Oh! that old book was in the way," she explained airily. "I want you to help me and you know perfectly well you can't read a book and pay attention to me at the same time."

"You will pardon me, my dear," I said, "I am afraid old age is creeping on apace and dimming the once bright intellect, but I am forced to admit that I do not follow your line of reasoning. Just between ourselves why should I pay attention to you?"

"What a silly question!" she exclaimed. "You are to listen to me because I want you to listen to me."

"Well," I admitted judicially, "now that you have put it in that light I can see the force of your argument. From now on, like Little Red Riding Hood's grandmother, I am all ears. What were you going to say?"

"Oh! Never mind that now," she hastily interrupted. "Tell me about Little Red Riding Hood."

"The wolf ate her," I assured her cheerfully, "and I know a certain young person who is in imminent danger of meeting a similar fate. If you look carefully you will note that all my teeth recently have been sharpened and pointed. Let's see now," eyeing her appraisingly while she shivered in delightfully terrified anticipation, "let's see now just where to snap the first bite."

Had I been allowed sufficient time I feel reasonably certain I could have convinced her of the folly of taking liberties with a sleeping lion, but in the midst of a rough and tumble melee we were interrupted by the young lady's mother. Any other person would have conducted an impartial investigation and placed the blame for the row on the guilty party, on the person directly responsible for shattering the peace and quietness of our humble cot at this hour of night.

TWO FEET, ONE SQUARE YARD

The lady does not believe in holding investigations. Law, evidence, justice and all the safeguards that have been built up laboriously through the centuries for protecting the liberty of the subject mean nothing, absolutely nothing to her. Despite the fact that I was the aggrieved party, the innocent victim of an insidious attempt to wreck a quiet evening, I was pronounced guilty without a hearing and with no chance of appeal. A dark threat that some day the worm would turn was dismissed flippantly.

"You're a fine worm," she said, "a book worm! You stick your nose in a silly old book and when a little innocent child goes to you for assistance in doing her home work, you snap at her! I heard what you said! Then you tried to twist her out of shape and break all the furniture in the house. Why can't you behave life any normal father—"

"How was I to know what she wanted," I protested. "Why did she not tell me? I am not a mind reader, a fortune teller, an interpreter of dreams, signs and omens. It she had told me what she wanted—"

"Next time," the lady explained sweetly, "she will write out an application for an interview three weeks in advance. She will place it on a silver tray and give it to a lackey who will approach humbly, assume a prone position and lay it at your august feet." "Why august?" I inquired suspiciously. "August is one of the longest months in the year," she explained, "also, one of the laziest." "Kindly leave my feet out of this argument," I said. "They suit me."

"You're easily pleased!"

"They suit me," I continued without heeding the interruption, "and have rendered me faithful and valiant service over a period of many years. Woodman, spare the tree and so forth, if you get my meaning. They have not exactly sheltered me, but—"

"But they would," she interrupted, "if you were to stand on your head, or your hands and let the precious old

paddlers droop fore and aft like a weeping willow tree."

The mental picture conjured by this brilliant flight of fancy seemed to tickle her beyond all reasonable bounds. She laughed—as our rising young writers say—immoderately.

Had she been any other person—well—almost any other person—I would have been tempted to quote a particularly biting and bitter comment coined by one *Jeremiah* several thousand years ago. Jerry had a rare gift along the line of pointed invective. Many times under stress of deep emotion I have gone to him for inspiration and have derived great comfort from perusing his writings. His happy reference to thorns crackling under a pot cannot be improved.

However, as I say, *Jeremiah* is strong medicine and only to be applied on comparatively rare occasions when one has been driven to the limit of human endurance and desirous at one swift blow to sever all personal and diplomatic relations. Certainly this was not one of these crucial occasions. I flashed the verse from *Jeremiah* on my own private mental screen, admired it for a few blissful seconds and then placed it back in the file for use on a more fitting occasion. Greatly refreshed and strengthened by this little bit of mental setting up exercise I joined—to the best of my ability—in the merry laughter, in the jocund spirit which seemed to prevail. The lady, apparently, greatly appreciated this evidence of co-operation—or surrender. "Let's deal a new hand all around." I suggested magnanimously, "wipe the slate clean. Blot out the past. Spit on our hands and take a new grip on the —on the—"

"If I was not a perfect lady," she said, "I would use one of that vulgar Bill's expressions and tell you that you are all wet. There is too much moisture in your program. Card playing, wiping, blotting and spitting may be appropriate enough among your tobacco chewing foundry friends, but I see no excuse for introducing a foundry atmosphere into the home where attentive little ears absorb everything they hear."

"I think you over estimate their capacity," I said, "or it may be that the owner of this particular pair of ears does not tune in at the right time. The teacher probably explained exactly what she wanted done tonight, but this gallant young scholar was listening to some other station at the time. Then this careless young person comes to me at night and attempts to place the last straw on the poor old camel's back. How about it, hey?"

The young lady assured me earnestly that I was doing her a grave injustice. Among all the students in her class she doubted if any single one worked as hard as she did, or paid more diligent attention to the stream of wisdom flowing from the teacher's desk. Although she did not use the exact comparison, I gathered in a general way that the lot of a galley slave toiling at the oar was a dream of bliss compared with the existence of a pupil in her school.

"You've no idea, Paw," she assured me, "of how hard we have to work in that old dump."

"Tut, tut," I remonstrated, "you

"THIS'LL KNOCK 'EM DEAD," SEZ HE

should not speak so disrespectfully of the dear old school. Sixty or seventy years from now when you are a little old woman with a shawl over your head, a hump on your back and a stick in your hand you will sit by the fire lapping gruel out of a saucer. Among all the fancies and memories that stream through your mind, those centering around your school days will give you the greatest pleasure. You would give your right eye, if such a thing was possible, to go back and live those happy carefree days over again."

"Gee! Paw," she said admiringly, "you have the grandest imagination! If you had to work as hard as I do every day you would change your mind about the happy carefree days. I guess it must have been different when you went to school. You did not have an old crabby teacher, never satisfied, always giving orders, and strict! Listen—"

"Old and crabby?" I repeated in surprise. "Why, I visited your class one day and I thought your teacher was a charming young lady."

"She is old," she insisted. "One of the girls told me that our teacher is nearly 30! Crabby?" rolling her eyes upward eloquently, "you don't know the half of it. Wait 'til I tell you what she did today. Just before the bell rang to dismiss the class she told us we had to write a composition on spring tonight. Can you imagine such crust? That is what I wanted you to help me with tonight."

"Fine," I said. "Go ahead and write the thing and I shall be very happy to look over it afterward and correct any mistakes."

"I don't call that any kind of help," she protested. "I have a better and much more simple plan. Listen. You write the composition and then I will copy it. Isn't that a swell plan?"

"Yes," I admitted. "It is a swell plan, but unfortunately the lingering remnant of a conscience still in my possession prevents me from doing what the legal fraternity describes as compounding a felony." "If you don't want to write the old thing," she suggested brightly, "just tell me about it and I'll write it down. Only please remember, no long words. If there is one thing I hate and despise it is long words that I can't spell. Why do people use long words?" "Laziness, my dear," I assured her, "just pure unadulterated laziness. The fashion was introduced by pedantic old curmudgeons who received compensation for their literary effusions on a page basis. They probably figured they would be silly to write several hundred words to a page, when 100 triple and quadruple-jointed words would fill the same space.

"If a humble suggestion is in order, I advise you to employ the same system. For example you might write: Spring! Beautiful spring with its exhilarating and invigorating atmosphere effectually puts to rout any last lingering remnants of the lassitude and inertia incident to a cooped up existence during the inclement season of winter. Cerulean azure of the firmament never is so effulgent and brilliant as—"

"You certainly are brilliant," the child's mother interrupted at this point, "brilliant in your ability to dodge anything in the shape of work. You have wasted enough time to write half a dozen compositions. It is now the child's bed time and I sincerely trust the remnant of a conscience you were bragging about some time back, will get busy and prevent you from sleeping this night!"

Fortunately I was rescued from this

desperate position by Bill's opportune arrival. To create a diversion I asked him what he knew about spring.

"What kind of spring?" he inquired. "Bed springs, well springs, watch springs, hope springs eternal or the flowers that bloom in the spring tra-la-la. Perhaps you are talking about the spring in a cope, hey?"

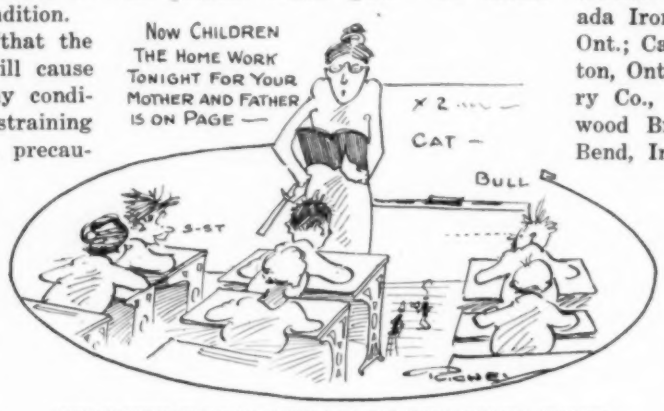
Without waiting for a reply he launched into a description of an inquiry he had from a foundryman recently. The inquiry was accompanied by a blueprint of a casting 55 inches in diameter, ⅝-inch thick with an opening 17 inches diameter in the center. The mold had been gated in the center and poured rapidly to prevent cold shuts. The iron pattern weighed 560 pounds, but the casting strained and as a result weighed 630 pounds. The foundryman wanted to know how to remedy this condition.

"I wrote him," Bill said, "that the large area of this casting will cause it to strain under almost any condition, but the extent of the straining may be minimized if certain precautions are observed. For example if he is equipped to make the mold in an iron flask and dry it in the oven, the casting will come out practically true to size and weight. However, from his letter head I gathered that all his castings are made in green sand molds, therefore what he needs is a hint on procedure.

"He did not state whether he is using a wood or an iron flask. Basing my opinion on the general practice in foundries where small and medium weight castings are made in green sand I assume he is making this casting in a square wood flask at least 6 feet from side to side. To insure the face of the cope from sagging, the back of this flask probably is crossed by a pair of *strongbacks*, pieces of 3 x 8 inch lumber with the ends resting on the ends of the flask and with chuck bars nailed to the sides and extending down between the bars. Where these chuck bars are nailed properly to the *strongbacks* and the bars, the entire assembly is fairly rigid and under ordinary circumstances is quite satisfactory. That is to say the assembly of bars, chucks and *strongbacks* will prevent the face of the cope from sagging while the mold is empty, or from lifting, due to the pressure of the metal when the mold is filled from a high head.

"In the present instance the pressure against the cope is accentuated due to the fact that the mold is poured in the center from a number of radiating gate channels that practically convert the casting into a continuous plate. The face of the mold is forced upward, thus increasing the thickness of the casting and consequently, the weight. He will find that the center of the mold is covered with a web of iron, thus indicating that the sand face of the cope was forced away from the corresponding sand face in the drag.

"The remedy of course is to tighten up all the woodwork in the cope and then either place weights on the *strongbacks* or reinforce them with steel or iron binders, extending from side to side of the flask and clamped to the battens on the bottom board. The tendency to strain may be greatly reduced by pouring the casting from four corners of the flask instead of the present center gate. He should



MORE TRUTH THAN POETRY ON THE BLACK BOARD

cut four *showup* risers in the center and scoop out a basin in the cope so that each riser may flow over at a height not over 6 inches. This latter precaution should be taken whether the metal is poured from the four corners or from the center. If poured from the center the risers can be cut at the four corners, or can be *popped* through at four equidistant points on top of the rim.

"If he is familiar with all the foregoing features and has governed himself accordingly, then the overweight of the casting may be traced to a faulty drag mold. Where the bottom board does not rest properly on the sand in the drag, or where the battens are not properly supported on the floor, the sand immediately in contact with the pattern sags away either at the time the drag is rolled over, or when the metal pressure is exerted later. Under either alternative the thickness of the mold cavity is increased and the thickness of the resulting casting is increased to the same extent.

"A cast-iron flask will remove most of the hazard attached to this casting even when molded in green sand, but with proper care and attention the casting may be molded in a wood flask. The character of the sand he is using may exert an influence on the final result. Fine, close sand must be rammed gently to prevent blisters and scabs. Naturally, a mold of that kind will yield more or less under static pressure. By using a good, open grade of sand the mold may be rammed quite firmly, provided it is properly vented with a wire."

Royer Sells Equipment

Royer Foundry & Machine Co., Wilkes Barre, Pa., sold sand separators to the following companies during the month of March: Aluminum Co. of America, Fairfield, Conn.; Atlas Brass Foundry Co., Columbus, O.; Bostick Stove Co., Lapeer, Mich,; Canada Iron Foundries Ltd., St. Thomas, Ont.; Canadian Locomotive Co., Kingston, Ont.; Crawford & Doherty Foundry Co., Portland, Oreg.; Fulton Harwood Brass & Aluminum Co., South Bend, Ind.; Hesse-Ersted Iron Works, Portland, Oreg.; International Harvester Co., Chicago; North Jersey Foundry Co., Little Falls, N. J.; Piston Ring Co., Muskegon, Mich,; Prescott Co., Muskegon, Mich,; Shawinigan Chemicals Ltd., Shawinigan Falls; Que.; Stearman Aircraft Co., Wichita, Kans.; Superior Engine Co., Springfield, O.; Union Iron Works, Spokane, Wash., and Wellman Bronze Co., Cleveland.

Distributes Bulletin

The University of Michigan is distributing a bulletin giving information on its courses in chemical engineering. The booklet tells of the development of the engineering profession and defines the word engineering. It also describes the equipment and facilities for instruction and research. Fellowships, summer employment and other subjects are discussed as also are admission requirements, fees and graduation requirements. The bulletin outlines the various courses in chemical engineering and gives some views of the engineering buildings on the campus. The catalog also gives a list of the papers that have been published by the present staff of the department of chemical engineering of the university.

Howard Goodman, 940 Seneca street, Buffalo, has been appointed agent for the General Naval Stores Co., Cincinnati. He formerly was connected with Spencer Kellogg Co., Buffalo.

Cleans Castings with Sand and Water

Fine Stream of Sand Enveloped in a Water Jet Removes Everything Movable from the Casting

BY E. A. CUSTER JR.

PROBABLY no feature in the production of a metallic casting has caused so much worry, annoyance and vexation as that of getting it properly cleaned. The nature of the operation is anything but inviting. The dirt, the refuse, the difficulty and the class of men that are forced by circumstance or necessity to engage in this occupation, all tend to create a feeling of repugnance.

The molder, working with new and carefully prepared materials amid relatively clean and comfortable surroundings looks down on the cleaning process. Besides, cleaning reveals hidden defects and he despises it. To the engineer, the problem of maintaining bearings, alignments and even the machinery itself in the face of dust, dirt and abuse, always is tinged with vexation. The big labor turnover in cleaning operations, complaints from salesmen and customers over the presence of sand on a shipped casting, daily cost figures both in operation and maintenance, combine to irritate and disgust the manager.

Castings must be cleaned. The cleaner they are the greater is the satisfaction of all concerned, and the better the reputation of the producer and his foundry. In spite of its lack of attraction, it has been inevitable that the engineer and the inventor should apply their brains and talent to solve this problem.

A One Man Job

Some have applied the rule of cause and effect and have tried to remove the cause rather than provide for the effect. They have worked hard and long in the development of permanent molds, metallic and otherwise, where no sand was necessary. To a measure, they have tasted success, but obviously, there can be but a small percentage of the total number of castings whose size or design will permit the use of that method of production.

Other engineers, and by far the greater number, have devoted themselves to the development of means of handling the effect, and many and ingenious are their productions. Looking back into the dirty, dusty cleaning rooms of the past, we can picture the first molders with their first castings. It was a one-man proposition in those days and the molder, in his joy over being able to produce a casting was content to clean it.

We can almost see him, with hammer, chisel, brush and stone, fondly working away to bring to light the result of his handiwork. As experiment gave way to production it became necessary to clean castings on a production basis. The skilled molder long since had divorced himself from that class of work and had left it to

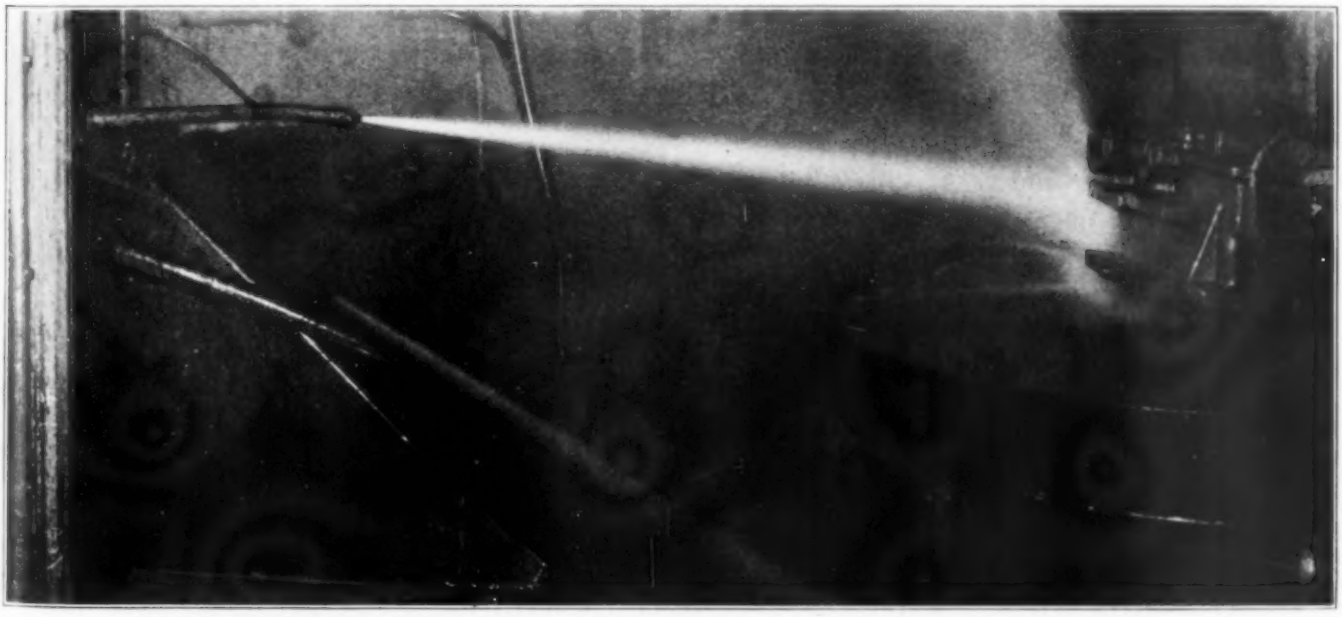


FIG. 1—THE HYDRAULIC ABRASIVE CLEANING CHAMBER IS ILLUMINATED WITH FLOOD LIGHTS

the less intelligent and cheaper paid men who could be prevailed upon to labor under such conditions.

Engineers have worked long and hard in developing the equipment now used in the cleaning room. The hand hammer and chisel gave way to the pneumatic and electric hammers, so prevalent in every foundry today. Use of compressed air, in another field suggested the sandblast. The stream of air, carrying particles of sharp, hard sand, cuts even the most refractory burnt sand with ease.

Many adaptations of the sandblast principle followed. Cabinets, revolving barrels, turntables, conveyors and elaborate machines were designed to dispense with the operator and present the various faces of the castings to the stream of sand.

While this development of the sandblast was going on, engineers were working in still another field and the hydraulic washers of castings were developed. These units, designed and used almost exclusively for large, heavily cored castings, found favor in the savings they effected in the removal of cores. The high pressure streams of water ripped out sand, rods and gaggers. Sand adhering to the surfaces of the casting was whisked off with one movement of the nozzle, provided the sand was not burned to the metal. Neither pressure nor duration of application of the stream of water would remove sand in that condition.

These washers salvaged rods and gaggers in the same shape as when first applied, thus facilitating their re-use. They eliminated the labor of digging out cores. The following description taken from a recently published book telling the story of a great plant's development refers to that method.

FIG. 2—HOLE DRILLED THROUGH A ½-INCH STEEL PLATE AT A DISTANCE OF 6 FEET

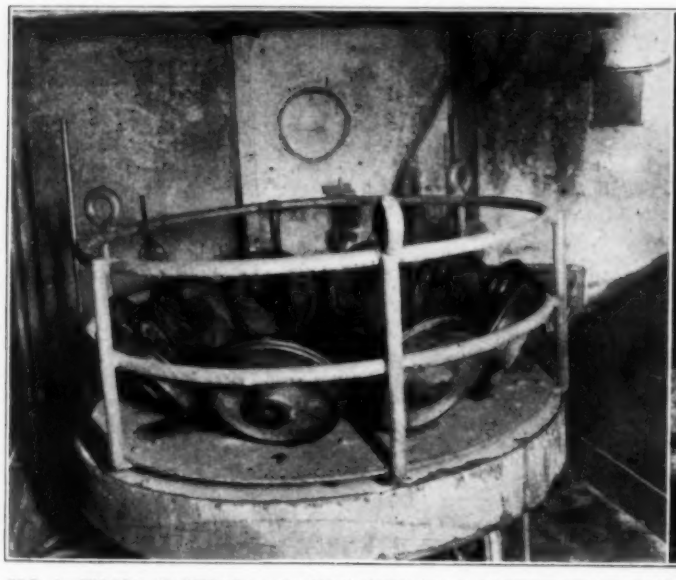
In days gone by the cleaning room was the bane of this foundry. Clouds of scorching dust filled it. In summer it was almost insupportable. Men worked in relays when they worked at all. Great ventilating fans struggled to make the air at least livable. Visitors rarely were shown this part of the foundry. It was one of the great problems. Hydraulic washing has changed all this. A stream of water at 350 pounds pressure sweeps off the sand adhering to the casting, drives into the most intricate passages and tears out the hard baked cores as though they were loose sand. A man behind a pane of safety glass deftly swings a monitor from the tip of which shoots a jet of water, hard and rigid as a bar of iron. High steel enclosures protect the rest of the shop from flying rods and shards of cores. A cylinder formerly cleaned with air jets and hand wielded steel bars in 6 hours now is finished in 40 minutes. Sand and water are collected in large settling basins from which the clean sand is lifted and sent back to the molding floors. From the top of the enclosure an impalpable mist rises and spreads over the cleaning room. It lays the dust, cools the air, makes this room one of the show places of the plant and has made work easier.

Separate and distinct from the problem of cleaning, yet in a measure related to it, engineers were working in another field; that of producing a correct molding sand. They knew that all natural molding sands varied more or less depending upon bed location, depth of strata or other factors of their original formation. This led to the creation and use in numerous places, of a synthetic sand. A sand built up from the clean white silica sand, properly bonded, humidified and blended for each specific use. This introduced a new problem in the cleaning room. In many places, particularly some of the steel foundries, the reclaimed sand is desired in the form of the white silica sand alone so that all sand used for molding can be mixed to one standard.

Thus the engineers, still working on the problems of cleaning the castings were confronted with the task of combining the speed of the washer with the efficiency of the sandblast, and at the same time provide for washing the sand itself to render it suitable for re-use.

They have succeeded. They have worked over the problem for the better part of two years and now give to the foundrymen the latest development, the hydraulic abrasive washer.

This new method originated and developed at the plant of the Whiting Corp., Harvey, Ill., simply combines the powerful streams of water with the abrasive action of sand. Actual combining of sand and water; means of putting both sand and water under pressure; cutting action of the sand on valves and controls; manipulating the nozzles; each presented a problem in itself, but all have been solved in a gratifying manner by the members



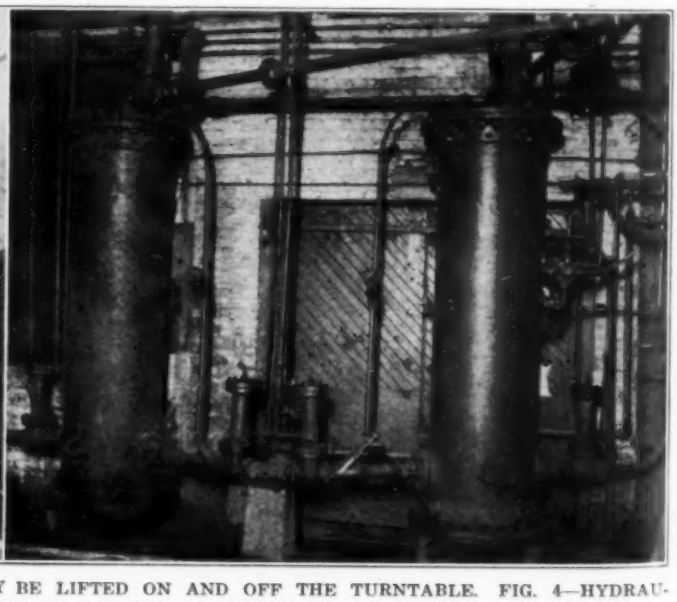


FIG. 3—SMALL CASTINGS ARE ENCLOSED IN A BASKET THAT MAY BE LIFTED ON AND OFF THE TURNTABLE. FIG. 4—HYDRAULICALLY OPERATED VALVES WITH FOUR-WAY CONTROL ARE SO DESIGNED THAT THERE IS NO INTERRUPTION OR PULSATION WHEN THE SUPPLY IS SWITCHED FROM ONE TO THE OTHER

of Whitney Corp. engineering staff.

The new device resembles the familiar pressure washers with the same steel rooms and the usual turntable in the center; the same settling basins where sand and water are segregated; the same mode of application, but better results.

In the early development of the abrasive washer it was apparent at once that the mixture of sand and water could not be passed through pumps to put it under pressure. The abrasive action quickly would cut out any pump, plunger or centrifugal. The siphon action of eductors was tried next and at once proved effective in mixing the sand and water, but the eductors alone would not do. A pressure of 500 pounds on an eductor such as had to be used would give only a theoretical discharge of 175 pounds. This low pressure is not sufficient to tear into cores nor to give the high abrasive action desired. The sand mixture itself had to be placed under pressure and this finally was accomplished by a large pressure tank. One tank caused an intermittent delay of 10 minutes or more each time the tank had to be refilled. This delay was overcome by the installation of a second tank. One fills while the other discharges under the control of an ingenious four-way valve. This insures a continuous supply to the nozzle.

Then came the question of abrasion. The sandblast had amply demonstrated the cutting power of sand when propelled by air under a nozzle pressure that rarely exceeds 50 pounds. The best of the sandblast nozzles seldom lasted more than a day. How much greater would be this wear when the pressure was jumped to 500 pounds was a matter of conjecture, but actual operation disclosed a surprising and gratifying fact. When a mixture of sand and water in which the water content is the greater, is propelled at high velocity, the sand collects in the center of the stream and the water acts as a sheath around it. The nozzles on the abrasive washer show little wear and their life is measured in weeks instead of hours. Similarly the piping and hose serve over a long period.

Wear showed only where the direction of the stream was changed abruptly in elbows and tees. When these sharp turns were displaced with wide swinging curves the wear was reduced. The same action of the sand and water seemed to hold true in the valves. When a valve that would not jam was developed finally, the question of wear was solved. Liners of the eductors wear to a considerable extent but they are replaceable. Replacements are necessary only about every two months.

The present hydraulic abrasive washer presents a unit that is comparatively simple, easy to understand and operate, and positive in action. A steel room is equipped with a door, or doors, in the ends, sides, top or all faces as the individual needs require. The castings are placed on a revolving table in the center of the room. This table may be fixed and the castings lowered upon it through the roof of the room, or it may be mounted on a truck and moved into the room through a side or end door. Movement of the table is controlled for either rotation or longitudal motion by valves at the operator's station. By a simple turn of his wrist he can move the table in or out or revolve it to present any face of the casting toward the nozzle.

A motor driven centrifugal pump located in a separate housing back of the washing room delivers the required amount and pressure of water. This water may be delivered to the nozzle direct for pressure washing or rinsing of castings. When the sand abrasive action is desired the water is passed through semi-eductors in the base of either one tank or the other. Here the water, under 500 pounds pressure picks up the sand also under the same pressure, folds around it until the sand is centered like the lead in a pencil, and carries it to the nozzle.

The nozzle is mounted on a movable rack so that it may be raised or lowered by a simple twist of a valve, to

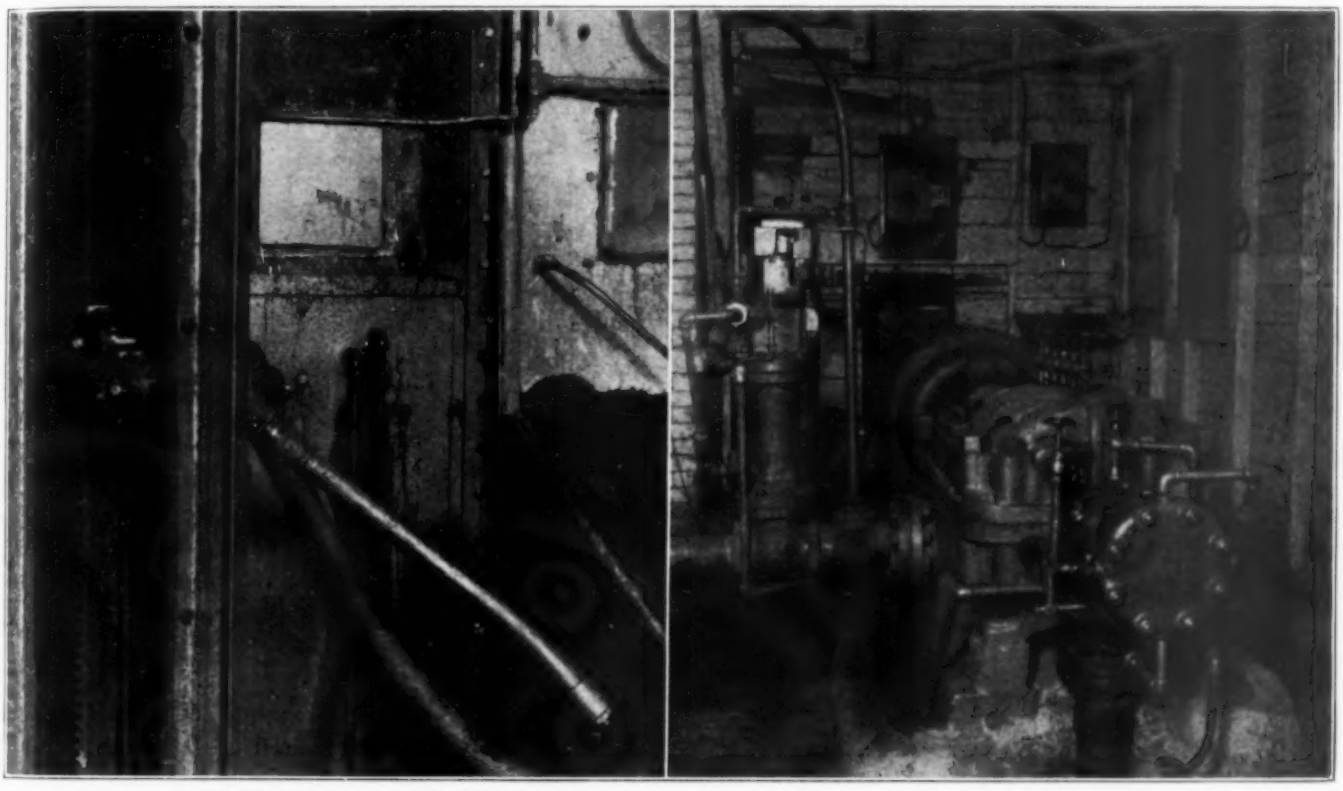


FIG. 5—NOZZLE WITH UNIVERSAL JOINT MAY BE RAISED OR LOWERED ON THE RACK SHOWN TO THE LEFT. FIG. 6—HYDRAULICALLY OPERATED VALVE AT THE LEFT CONTROLS FEED TO PRESSURE TANK AND OPENS OR CLOSES AUTOMATICALLY AS THE MOTOR IS TURNED ON OR SHUT OFF

any position from roof to floor. The nozzle is connected to the rack with a universal joint that permits free movement of the nozzle in any direction.

Water, sand, gaggers, everything loose, is washed across the sloping floor of the room to the first of a series of tanks in the floor. A vibrating screen over the tank catches gaggers, rods, nails, etc., while the sand and water drop through into the tank. From here the sand is picked up by low pressure eductors and delivered either to the two tanks for re-use as abrasive or to drainage and sand driers for reconditioning for the foundry. The water passes from tank to tank over a series of wiers until it is clear for re-use. In the second last tank fine coke acts as a filter for any fine silt that may have passed over. The pump draws from the last tank in this self supporting unit needing neither new sand aditions nor additional water.

The hydraulic abrasive washer will cut through burned sand on a steel casting; remove scale and rust, paint, or the metal itself if the application is maintained at one point. The water seems to not only carry the sand to the casting but to literally hold it there and rub it across the surface. The cutting power is that of sand traveling with all the velocity of 500 pounds pressure. It will do just as effective work 6 feet or more from the nozzle as at 1 foot. This is demonstrated daily and the necessity no longer exists of keeping the nozzle close to the work. The cutting power of the stream is illustrated in the illustration Fig. 2. A steel plate, ½-inch thick, was placed 6 feet from the nozzle and drilled entirely through in 6 minutes.

If rusting is objectionable it is easily prevented by the addition to the water supply of about two buckets of an anti-rust solution each day. Castings cleaned when this solution was used have failed to rust although exposed to the weather for weeks.

The violent scrubbing action of the sand not only cleans the castings but also cleans the sand itself. As it comes from the washer it is free from bond or carbon and when freed from the excess water is ready for reconditioning.

Wants Pattern Equipment

Alexander Ries, Hilcrest road, Camp Hill, Brisbane, Australia, desires to purchase patterns for cast toys, ash trays, bookends and similar castings. He also is in the market for American rigging and patterns to make castings for gas and coal stoves.

Fellowships Available

By arrangement with the graduate school, college of engineers, engineering experiment station and the Columbus branch, United States bureau of mines, and a number of donors, several fellowships for graduate study in engineering are available at Ohio State university. The fellowships are awarded to holders of bachelor's and master's degrees. The holders are exempt from all fees except matriculation and diploma and required to do no teaching. Research projects, including thesis, constitute a large portion of the required work and are supplemented by approved graduate courses. Ordinarily one year's residence is sufficient to enable the fellow to obtain a master's degree. The holders of fellowships may apply for renewal at the end of each year and the holders are encouraged to work for a doctor's degree. The stipend for the school year, nine months, is $750. Additional information and application blanks for the various fellowships may be obtained from Dean, Graduate school, Ohio State university, Columbus, O., for donored fellowships and from Director, Engineering Experiment station, Ohio State university, Columbus, O., for industrial fellowships.

Hold Spring Group Meet

The annual spring group meeting of the committees of the American Society for Testing Materials was held in Chicago, March 19 to 22 at the Stevens hotel. About 25 committees participated in approximately 93 sessions held during the four days of the meeting. Committee A-1 on steel under Chairman J. B. Young, engineer of tests, Reading Co., Reading, Pa., recommended for advancement to standard, including revisions, tentative specifications for carbon-steel castings for valves, flanges, and fittings for high-temperature service; for lap-welded and seamless steel pipe for high-temperature service, and for structural steel for locomotives and cars. Other tentative revisions of standards for structural steels also were recommended for adoption as standard. Committee A-3 on cast iron under Chairman H. Bornstein, Deere & Co., Moline, Ill., approved new specifications for shelf stock valves and fittings as tentative standards. Work of the subcommittee on the correlation of test bars and castings has been continued and some valuable data will appear in the annual report of the committee. The subcommittee on heat treatment of cast iron is preparing a digest of all literature published since 1908, on the subject and expects to publish it in 1930.

Committee A-5 on corrosion of iron and steel with J. H. Gibboney, Norfolk & Western Railway Co., Roanoke, Va., as chairman, is investigating atmospheric corrosion on various types of zinc-coated products at Pittsburgh, State College, Pa., Altoona, Pa., Sandy Hook, N. Y., and Key West, Fla. Committee D-5 on coal and coke under Chairman A. C. Fieldner, bureau of mines, Washington, recommended the advancement to standards, tentative methods for determination of sulphur in coal and coke by bomb-washing and sodium peroxide fusion; test for cubic foot weight of crushed bituminous coal; test for cubic foot weight of coke; test for sieve analysis of coke, and tumbler test for coke. This committee also recommended approval as tentative standards, methods for test for sieve analysis of crushed bituminous coal, and test for size of anthracite.

Gives Monthly Tonnage

Foundry council, Worcester, Mass., composed of eleven foundries in that vicinity, reports a decrease in tonnage for January compared with December but a gain over January, 1928. Comparisons by months for the past year follow:

1928	Pounds
January	2,914,072
February	3,344,557
March	3,766,107
April	3,504,179
May	3,683,065
June	3,439,880
July	3,465,559
August	3,181,115
September	3,110,968
October	3,709,744
November	3,981,883
December	4,175,119
	42,276,248
1929	
January	3,841,380

Quad City Group Meets

The March meeting of the Quad City Foundrymen's association was addressed by A. Van Lantschoot, research engineer, Iowa Malleable Iron Co., Fairfield, Ia. Mr. Van Lantschoot described the use of oil, both as a furnace fuel and as a heat supply for annealing ovens. S. T. Johnston, president, American Foundrymen's association, and C. E. Hoyt, executive secretary, were special guests at the meeting. Other guests included J. Anderson, J. Mueller, D. Huntington and E. Erickson, winners of the apprentice pattern making contest and W. Clough, J. Stauber and A. Varner, apprentice molding contest winners.

The FOUNDRY Family Photograph Album

Upper Left

W. E. PAULSON

Thos. Paulson & Sons Inc., Brooklyn, N. Y.

Lower Left

D. J. KILBY

Kilby Mfg. Co., Cleveland

Upper Right

J. A. KELLY

Reliance Steel Casting Co., Pittsburgh

Lower Right

R. E. TURNBULL

Arcade Mfg. Co., Freeport, Ill.

SCRAP METAL SPECIFICATIONS

(*Continued from Data Sheet No. 760*)

Car Bolsters

Car bolsters will consist of railroad car steel bolsters and side frames stripped clean of all iron attachments. Not over 24 inches wide and cut to lengths not over 48 inches.

Medium Silicon Scrap

Medium silicon scrap will consist of high silicon billet, bloom, bar crops, plate crops, or sheet-bar crops, not over 0.04 per cent phosphorus or sulphur, not less than 0.05 per cent to 2 per cent silicon, free from other alloys, not less than ¼-inch thick, not over 18 inches wide and 36 inches long, and no piece to weigh less than 10 pounds or more than 500 pounds. To be free from needle and sliver stock. Must be new material and free from excessive rust.

High Silicon Scrap

High silicon scrap will consist of high silicon billet, bloom, bar crops, plate crops, or sheet-bar crops, not over 0.04 per cent phosphorus or sulphur, not less than 2 per cent or over 4.5 per cent silicon, free from other alloys, not less than ¼-inch thick, not over 18 inches wide and 36 inches long, and no piece to weigh less than 10 pounds or more than 500 pounds. To be free from needle and sliver stock. Must be new material and free from excessive rust.

High Nickel Scrap

High nickel scrap will consist of nickel steel billet, bloom, bar crops, or other shapes of similar section and equal grade, not over 0.04 per cent phosphorus or sulphur, between 3 per cent and 3.5 per cent nickel (lower or higher in nickel content to be considered duly), free from other alloys. Not less than 2 inches square or diameter, not over 18 inches wide, and cut to lengths suitable for charging boxes of buyers, and no piece to weigh less than 25 pounds. Must be clean material.

No. 1 Chrome Nickel Scrap

No. 1 chrome nickel scrap will consist of chrome nickel steel billet, bloom, bar crops, or other shapes of similar section and equal grade, not over 0.04 per cent phosphorus or sulphur, between 3 and 3.5 per cent nickel

(*Continued on Data Sheet No. 762*)

SCRAP METAL SPECIFICATIONS

(*Continued from Data Sheet No. 761*)

(lower or higher nickel content to be duly considered), not over 0.5 per cent chrome, free from other alloys. Not less than 2 inches square or diameter, not over 18 inches wide, and cut to lengths suitable for buyers' charging boxes, and no piece to weigh less than 25 pounds. Must be clean material.

No. 2 Chrome Nickel Scrap

No. 2 chrome nickel scrap will consist of chrome nickel steel billet, bloom, bar crops, or other shapes of similar section and equal grade, not over 0.04 per cent phosphorus or sulphur, between 1.5 and 2.5 per cent nickel (lower or higher nickel content to be duly considered), between 0.5 and 1 per cent chrome, free from other alloys. Not less than 2 inches square or diameter, not over 18 inches wide, and cut to lengths suitable for buyers' charging boxes, and no piece to weigh less than 25 pounds. Must be clean material.

Light Chrome Nickel Scrap

Light chrome nickel scrap will consist of nickel or chrome nickel steel of the analyses and descriptions as shown for long flashings, mixed flashings and No. 1 busheling, except it may be lighter and of miscellaneous shapes. To be fully described at time of sale and purchase.

Special Chrome Nickel Scrap

Special chrome nickel scrap will consist of nickel or chrome nickel steel of the analyses and descriptions as shown for grades long flashings, mixed flashings and No. 1 busheling, except the phosphorus and sulphur may go up to but not over 0.05 per cent. To be fully described at time of sale and purchase.

Nickel Steel Turnings

Nickel steel turnings will consist of heavy short first-cut turnings from nickel steel forgings. Nickel and chrome content to be specified on each individual sale. To weigh not less than 75 pounds per cubic foot. To be free from dirt and other foreign materials.

(*Concluded on Data Sheet No. 763*)

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

BRITISH INSTITUTE OF METALS
Celebrates Anniversary

Technical Sessions, Banquet and Exhibition Are Well Attended—Interesting Papers and Discussions Liven Busy Two-day Meeting

SPECIAL importance was attached this year to the annual meeting of the British Institute of Metals, which was held in London, March 13 and 14, because this meeting commemorated the coming-of-age of the institute, which was founded 21 years ago. The attendance was particularly large, both at the technical sessions and at the banquet. A special feature was the conversazione and metallurgical exhibition, which was held at the Science museum, London, on Thursday, March 14. This event, which will be described later, was attended by about 600 guests.

The meeting opened on Wednesday, March 13, in the hall of the Institution of Mechanical Engineers, Westminster, Dr. W. Rosenhain presiding. G. Shaw Scott, who has been secretary and editor of the *Journal* of the institute since its foundation, read the report of the council. The institute membership now has attained the figure of 2022. It was pointed out that the overseas membership has attained one-third of the total membership. Mention was made of the increased accommodation that has been made during the past year on the premises of the institute, the library space having been increased by 100 per cent.

The council has in hand arrangements for the next autumn meeting, to be held in Dusseldorf, Germany, Sept. 9 to 12, by invitation of the Verein Deutscher Ingenieure and of the Deutsche Gesellschaft fur Metallkunde. Steps also are being taken in connection with the visit of the institute to America in 1932.

The result of the election of the council for 1929-30 was declared as follows: President, Dr. Walter Rosenhain, National Physical Laboratory, Teddington, who holds office for the second year in succession; vice presidents, T. Bolton, T. Bolton & Sons, Ltd., London; Sir Henry Fowler, chief mechanical engineer, London, Midland and Scottish Railway Co., Derby; members of council, R. Lloyd Gibbins, Birmingham Battery & Metal Co., Ltd., Birmingham; Dr. H. Moore, London; H. A. Ruck-Keene, Lloyds Register of Shipping, London; J. Steven, Steven & Struthers, Ltd., Glasgow; W. G. Turner, William Turner & Co., Sheffield; and H. B. Weeks, London.

Dr. Maas, head of the German committee on corrosion research, addressed the meeting and presented the greetings of his German colleagues on the occasion of the twenty-first anniversary. He made reference to the work effected by the corrosion research committee and suggested close co-operation with the German national committee for the protection of metals. This proposal was endorsed by Dr. Rosenhain.

Presented Bronze Plaque

Professor Hanson, member of council, then informed the meeting that a profile bronze plaque of Dr. Rosenhain had been presented to the institute, to be housed in the institute offices to commemorate Dr. Rosenhain's presidency at the time of the twenty-first anniversary of the institute. Reference was made to the advance in metallurgical research for which Dr. Rosenhain is responsible, and also to the support that he has given to the institute since its foundation.

During the morning session the following papers were presented: "Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems," by Professor P. Saldau, Mining Institute of Leningrad, Leningrad, Russia; "Work-Softening and a Theory of Intercrystalline Cohesion," by F. Hargreaves and R. J. Hills, Southern Railway Co., Ashford, Kent; "Notes on the Testing of Electro-deposits on Aluminum," by G. B. Brook and Geo. H. Stott, British Aluminium Co., Ltd., Kinlochleven.

Included in the papers presented in the afternoon were: "The Age-Hardening of Some Aluminium Alloys," by Dr. Marie L. V. Gayler and G. D. Preston, department of metallurgy and metallurgical chemistry, National physical laboratory; "Brittleness in Arsenical Copper—II," by Clement Blazey, metallurgist at Metal Manufacturers' Property, Ltd., Port Kembla, New South Wales; "A Note on the Haughton-Hanson Thermostat. A Method of Fine Adjustment," by P. J. Durrant; "The System Magnesium-Zinc," by W. Hume-Rothery, Magdalen college, Oxford, and E. Rounsefell, Lincoln college, Oxford.

One of the papers presented on Thursday morning, March 14 was, "An Improved Form of Electric Resistance Furnace," by Dr. W. Rosenhain and W. E. Prytherch, National physical Laboratory, Teddington. The paper described an electric resistance furnace for which advantages are claimed in regard to higher available working temperatures, up to 1400 degrees Cent., durability, and freedom from oxidation of the carbon resistor. The heating element of this type of furnace consists of carbon or graphite pellets, or short rods placed end to end in a refractory sheathing tube which fits easily over them. Heating occurs by contact resistance. The sheathing tube prevents the access of air sufficiently to avoid any appreciable burning of the carbon.

G. Barnard mentioned that he had had experience with furnaces packed with lamp black. He mentioned certain large furnaces, up to 4 feet in length, used to heat lamp filaments and made up of plates of carbon forming a box. The filaments were put into the furnace and packed with graphite. The temperature reached 3500 degrees Fahr.

Replying to the discussion, Dr. Rosenhain stated that one advantage of the furnace he had described is that there is no carbon in the atmosphere. He said, however, that this furnace was not calculated for such high temperatures as those mentioned by Mr. Barnard. He said, on the other hand, that the resistor still was good after more than 100 hours at 1300 degrees. He stated that it is not necessary to have a gas-tight sheath, as the air or gases formed during the combustion are a sufficient protection against the outside atmosphere. As a refrac-

tory he uses a German porcelain that will stand up to 1400 degrees at the most, but which stood the temperature of 1300 degrees without any mishap. Dr. Rosenhain thinks that special refractories should be made, but he does not think that for the time being the temperature of 1800 degrees could be exceeded.

A paper by D. F. Campbell, Campbell and Gifford, London, entitled, "Recent Developments in Electric Furnaces," was followed by an interesting discussion. The paper described the improvements and modifications in melting practice during the past two years, and discussed the relative performance of small and large induction furnaces, and the reasons for selecting the size of unit according to the work to be done. A short description of improvements in practice with high-frequency furnaces and details of new methods of lining these furnaces were given. A general survey of heat-treatment followed, with a detailed description of the construction and performance of a number of specific furnaces, including a continuous furnace for annealing brass strip.

Discusses Furnace Efficiency

Discussion was opened by A. G. Lobley, who said that it is no simple matter to specify the thermal efficiency of a furnace. He stated that it is difficult to determine the heat loss of the furnace, and that methods generally used to determine this loss are not sufficiently accurate. To define the efficiency of a furnace he would prefer to use the figure of consumption per ton of material. He pointed out that when considering the question of cost, there are cases where an electric furnace can bring about a reduction in general overhead costs which more than compensates the cost of installation and the cost of operation.

Dr. Brownsdon, Birmingham, emphasized the difficulty of the refractory problem, and pointed out that the life of the refractory is an important item in figuring costs. In the speaker's opinion, the question of agitation of the metal in an induction furnace can be exaggerated. Dr. Hudson, director of the British Non-Ferrous Metals Research association, Birmingham, said that there has been an advance in the preparation of refractories in Germany.

Mr. Barclay stated that there still is a long way to go before all the factors bearing on the success of high-frequency furnaces can be known. He suggested that linings exist much longer in arc furnaces, and said that he had used linings for the melting of pure nickel and nickel alloys that had run for as long as 12 months. T. H. Turner, of Birmingham, referred to two types of furnaces used in America made in the form of inverted boxes, which can be lowered from the roof of the shop.

Dr. Rosenhain, referring to the question of agitation of the metal in the bath, said that in the manufacture of steel this agitation gives a quicker equilibrium of the steel and of the slag conditions. On the other hand, some small impurities get included in the bath, and he thinks that there is a certain amount of convection. To remedy this, he suggested stopping the current for a time and letting the bath rest. He emphasized the fact that induction furnaces permit of the control of the gases in the atmosphere of the furnace, and he mentioned that Dr. Rohn, Hanau am Main, Germany, had been able to obtain melts in vacuo with induction furnaces.

In replying to the discussion, Mr. Campbell stated that in comparing arc furnaces and high-frequency furnaces, account should be taken of the fact that conditions differ where a basic or an acid process is employed. He said that in practice the bath is rested by reducing the load, so as to reduce the agitation.

In the afternoon the papers presented were: "Alloys of Zirconinum—II," by C. Sykes, Metropolitan-Vickers research scholar, the University, Sheffield; "The Resistance of Zinc to Indentation. A Preliminary Account," by J. Newton Friend and W. E. Thorneycroft, of the department of chemistry, Ceneral Technical college, Birmingham; "The Solution of Plain and Amalgamated Zincs in Electric Batteries," and "The Silver Contents of Specimens of Ancient and Mediaeval Lead," by the same authors.

Large Attendance at Dinner

At the dinner which took place on Wednesday, March 13, nearly 300 guests were present, and among the speakers were Lord Melchett, chairman of Imperial Chemical Industries, Ltd., and Sir Samuel Hoare, air minister.

The metallurgical exhibition which took place in conjunction with the conversazione on Thursday, March 14, included exhibits by the British Aluminium Co., Ltd., and the Bureau of Information on Nickel, whose exhibit illustrated the wide range of alloys in which nickel performs an important function and indicated some of the properties and applications of this metal and its alloys. S. Cowper-Coles showed specimens with micrographs of electrolytic copper deposited under varying conditions. Professor C. H. Desch showed drawings of apparatus designed by Dr. C. J. Smith for the determination of changes of volume of metals during solidification. Drawings of a new continuous flow calorimeter for the accurate determination of the heats of solution of metals, also designed by Dr. C. J. Smith, and photographs of ingot sections of nonferrous metals also were included. P. F. Dujardin & Co. showed specimens of nonferrous metals and alloys. At the exhibit by High Duty Alloys, Ltd., Dr. C. F. Elam showed the application of X-rays to the study of metals. The exhibit of Light Alloys, Ltd., showed the structures, both external and internal, of aluminum silicon alloy of a composition typical of present-day commercial use, in comparison with the similar structures of other aluminimum alloys in common use.

Describes Exhibit

The London, Midland & Scottish Railway Co. showed an unusual fracture of copper rod as used for the manufacture of locomotive firebox stays. Exhibits by the National physical laboratory included pure metals and elements, single crystals of metals, samples of beryllium, samples of special refractories, a study of the effect of impurities in copper, samples of alloys for use at high temperatures and other exhibits.

The Research department, Woolwich, showed examples of the intercrystalline cracking of lead, sections of ingots of various brass alloys, micrographs showing intercrystalline fracture in metals, and applications of X-rays for the study of metals.

The Royal Aircraft Establishment, South Farnborough, displayed spars, struts, tubes and ribs made in duralumin, and forged duralumin airscrews and windmills; also samples of electro-deposited zinc on aluminum, duralumin and other metals. The Royal Mint showed ancient gold and silver trial plates and an arc spectra of pure gold. The Sir John Cass Technical institute exhibited the Chevenard thermic analyser as used in the department of metallurgy, a sheet metal testing apparatus, a yield point indicator, and apparatus for electrogravimetric and potentiotitrimetric analysis. D. & J. Tullis, Ltd., showed specimens of alloys and the results of corrosion tests. W. H. J. Vernon exhibited specimens showing atmospheric tarnishing and corrosion of metals. Henry Wiggin & Co., Ltd., exhibited a chiming clock with solid drawn tubes, examples of the alloy fittings put in the building of Imperial Chemical Industries, Ltd., alloy and pure nickel tubes, and gas-welded nickel-chromium tubes.

Is *Chemistry* of Value in the Gray Iron Foundry?

By Victor E. Hillman

AT THE outset it is well to scrutinize the chemical laboratory in a gray iron foundry. What is its value? What purpose does it serve? What is its sphere of usefulness? To what extent is the application of chemistry limited? Admittedly it has found a niche in the foundry insofar as the analysis of raw material is concerned. This fact is undisputed. Coke, limestone and pig iron are purchased according to specification, and an occasional analysis is desirable.

Generally speaking, however, the invoice analysis is sufficient for all practical purposes. The coke ovens, the blast furnaces and perchance the quarries, furnish analytical results which are extremely accurate and reliable. Occasionally a car may become mixed or an improper grade of iron substituted, but such instances are the exception and not the rule. Thousands of small foundries are operating on the invoice or furnace analysis. Good castings are being produced. Money is being made and reputations are being established.

Benefits Not Commensurate

Therefore, while the chemical analysis of raw material may be desirable for an occasional check, the benefits to be derived from regular routine analyses of raw material are not commensurate with expense involved. Rejections are few and far between. Moreover, when an opportunity to reject a carload of coke, or pig iron presents itself, a dispute usually arises as to the method and manner of sampling. After several conferences the furnace analysis usually is accepted as being the most accurate.

The next pertinent question centers around the value of chemistry in controlling the iron as it emerges from the cupola. Total carbon determinations are useless. Carbon cannot be controlled either in the blast furnace or in the cupola. It may be reduced by the addition of steel, but it cannot be regulated by altering the charge, the blast or the slag. Therefore, if an analysis should indicate 3.50 per cent carbon when 3.25 per cent is desired, what is to be done about it?

Metallurgists have contributed generously to the effect which carbon exerts on strength, depth of chill, softness, and fluidity, but the author never has seen a practical idea advanced that will produce concordant results for obtaining a predetermined percentage of carbon in the cupola. Hence, carbon analyses are of no value for control purposes. In the steel foundry, carbon determinations are of value because the furnace operator has ways and means at his command for reducing or raising the percentage of the element.

However, the same situation does not arise in cupola practice. Moreover, carbon determinations in gray iron are uncertain and indefinite. They lack concordancy due to the large amount of loose graphite present. Different analysts report results that are at wide variance with one another. By the same token combined and graphitic carbon analyses serve no practical purpose. These values are a function of the cooling rate. Rapid cooling will yield high combined carbon and low graphite. Slow cooling will produce just the opposite effect. Combined and graphitic carbon determinations offer little or no solution to foundry difficulties.

Percentage of silicon in cupola metal can be controlled by using the invoice or blast furnace analysis. If the analysis of the raw material is known the analysis of the finished product will take care of itself automatically according to the method of mixing. Moreover, silicon values vary 50 points in cupola operation and the analysis of scrap is an unknown quantity.

Lacks Control

Assuming that the percentage of silicon is a trifle high or low, what corrective measures are possible if the raw material conforms to specifications? Thousands of silicon analyses have passed the author's desk. No action ever was taken in reference to the specifications. Occasionally the percentage would be above or below specifications. What of it? What control is possible? Iron as it is sampled from the cupola may favor the high silicon portion of the charge; it may consist essentially of scrap or it may be a mixture of both.

These remarks are particularly true if no mixing ladle is used. Briefly, the author is opposed to any analytical procedure whose results serve no practical end. A cupola is a rapid and economical means of melting iron. It is unlike a bath of metal which may be corrected before pouring. It is not subject to nicety of control. The analysis of the metal cannot be maintained within narrow limits.

Sulphur analyses are of little or no avail. Coke has a predetermined amount of sulphur, generally under one per cent. The sulphur in scrap is around 0.1 per cent. In pig iron this element is under 0.04 per cent. Hence, the iron as it flows from the cupola will contain 0.09 per cent or

Disagrees with Stand

WHILE most foundrymen believe that chemistry in the gray iron foundry is of material value in obtaining good castings, the author of this article disagrees strongly with this stand. His contention is that the metal cannot be controlled in the cupola like in the steel furnace. While tearing down the value of chemistry in the foundry, the author offers constructive advice by urging more attention to design, gating, venting, etc. Victor E. Hillman, the author, is director of research, Crompton & Knowles Loom Works, Worcester, Mass.

thereabouts. Of what value is a sulphur determination if no means are available for controlling it? Sulphur can be reduced in the ladle by alkalies and patented nostrums. Of what value is 0.03 per cent sulphur in a casting? Did such a rigid specification ever contribute to the soundness of a casting? Never. The author has analysed over 7000 defective castings, and never once was he in a position to diagnose the cause of the trouble by a chemical analysis. Castings will shrink with high sulphur and with low sulphur. The evil effects of sulphur are a myth. Good castings are made with any and all reasonable percentages of sulphur.

Phosphorus is another element that is misrepresented. It masquerades under the guise of fluidity. In the earlier days stove plate and intricate castings were cast from high phosphorus iron. Iron today may be equally fluid with high or low phosphorus. There are many claims for low phosphorus irons. The author challenges anyone to set forth definite, concrete, concordant and undisputable evidence upon the difference between 0.25 and 0.75 per cent phosphorus in a mixture. Still, pig iron manufacturers are extolling the virtues of low phosphorus pig iron. It will do this. It will do that, but not one will present results to substantiate his viewpoint. Vague arguments are the rule. Concrete data is the exception.

Differences Exist

Chemistry has been unable to determine wherein one brand of pig iron differs from another. This statement presupposes that both analyses are identical. Every foundryman recognizes that some pig irons possess higher liquid shrinkage than others. Analyses may conform to specifications, and microstructures may be identical, but there is a striking dissimilarity between pig irons insofar as the action of the metal in the mold is concerned.

Oxidized iron, high and low blast, excessive use of scrap in the blast furnace burden, driving the furnace, coke economy and the inherent shortcomings of certain ores have been advanced as being responsible for *off irons*, but no one has ever come forth with definite evidence to substantiate the arguments. Reasons advanced for the havoc which some irons play in the foundry are commonplace and insipid. The industry is suffering from vague data. Foundrymen indulge in too many platitudes. Chemistry or metallography may solve the problem but to date there is a dearth of information on the subject. If chemistry could determine wherein one brand of pig iron differed from another it would extend its frontier and command a leading place in the gray iron industry. This is a fertile field for academic and university research, but not for practical foundrymen.

Analyses Fail to Help

A thorough investigation was conducted regarding the difficulty encountered in machining certain castings. Sulphur determinations offered no clue. Combined carbon values were equally useless. Moreover, the percentages of total and graphitic carbon did not aid the investigation. It was found that in nearly every instance where machining difficulty was encountered the trouble was occasioned by improper speeds and feeds.

A 10-inch milling cutter was operating at a speed of 61 revolutions per minute. Thirty revolutions per minute is the proper speed for a 10-inch cutter. Excessive drill speeds were also encountered. A ½-inch drill was operating at 970 revolutions per minute. It should have been operating at 610 revolutions per minute. Hard iron occasioned by the aforementioned conditions was charged to the foundry. The charge was manifestly unjust. When the machine shop attempts to violate some of the fundamental principles incident to the turning, planing or drilling of gray iron, the foundry should not be held responsible.

The previously mentioned ideas are designed primarily for gray iron foundrymen whose task is to make a suitable rate of return on his investment and whose aim is to produce castings that are sound, free from porosity and shrinkage flaws. This article will have little attraction to the third decimal point analyst, the ultra theorist, the intellectual mastadon or the research engineer who never has a practical idea in his head and who remains on the payroll by befogging issues and throwing sand in the eyes of his associates. The real objector to this article will be the man who never solved a problem except on paper, who indulges in mental gymnastics. The man who specializes in algebraic and integral signs and who never contributed to the soundness of a casting or never removed a shrink in all of his years of experience.

It might be inferred from this article that the chemist has no place in the grey iron foundry. However, such is not the case. An analyst with his trained power of observation, with his ability to associate cause with effect and his inclination to separate the chaff from the wheat, can render valuable service to the foundry. The chemist to be of service must discard his test tubes and acids. Chemistry never contributed to the soundness of a casting. Analytical procedure never removed a shrinkage flaw. Silicon and sulphur determinations have had no effect in reducing the scrap heap.

Real value of a scientific man in a foundry arises through his thorough study of design. More foundry losses have their inception in the engineering department than anywhere else. Heavy and light adjacent sections are always a source of annoyance to the foundryman. Hard ramming, improper gating and feeding, injudicious location of risers and insufficient height of cope have all added their toll to the scrap pile.

In conclusion, foundrymen are urged to take interest in those dwellings which are designated by the expressive term *laboratories*. Demand that they be multiplied, that they be adorned, but let them be laboratories of design, gating, venting, feeding, risers, ramming, cores and sand. These are the temples of the future, temples of well being and sound castings.

Three Foundries To Be Built in Russia

Frank D. Chase, Inc., Chicago, engineer and architect, has completed negotiations with officials of the United States of Soviet Republics for the construction of three foundries in Russia. The foundries will be situated near Leningrad, at Stalingrad and near Moscow. The first two will be tractor plants with capacities of 50 and 150 tractors a day respectively and the third will be a sewing machine factory with an output of 400 machines a day. The plans call for an expenditure of approximately $5,300,000.

Investigate Alloys

An investigation of the thermal expansion of magnesium and some of its alloys recently was made by the bureau of standards and the results have been published in research paper No. 29. It gives the data on linear thermal expansion of 6 samples of cast and extruded magnesium and 11 samples of cast and extruded magnesium alloy. Investigations were through temperature ranges between −183 and +500 degrees Cent. Price of the bulletin is 10 cents.

Titgen-Eastwood Co., Philadelphia, has removed its offices from Luzerne and D streets, to 3562 North Salmon street, Philadelphia.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Makes Beryllium Alloys

Beryllium Alloys, by W. Werner, *Metal Industry*, London, Nov. 16, 1928.

This short article is abstracted from one published in the *Zeitschrift fuer Metallkunde* by G. Masing and O. Dahl. It deals with experiments carried out by Masing and Dahl on beryllium-copper, beryllium-nickel, beryllium-cobalt and beryllium-iron. In the beryllium-copper alloys brinell hardness, tensile and transverse strengths were increased but the elongation was decreased considerably. Up to 5 per cent beryllium was used, and the alloys can be rolled, stamped and extruded. Corrosion resistence is about the same as that of tin and aluminum alloys. Beryllium-nickel alloys containing up to 2 per cent beryllium can be rolled well. Pure beryllium-cobalt alloys cannot be rolled but when some iron is added at about 500 degrees Cent., rolling can be done in the cold. Two tables included in the article present data on the composition of the various alloys used, the annealing and quenching temperatures, and the brinell hardness.

Improving Cast Iron

The Development of High Duty Cast Iron, by F. D. Corbin, *Foundry Trade Journal*, London, Jan. 31, 1929.

According to the author improvement of cast iron consists in lowering the amount of graphite and obtaining it in a nodular or rounded form as evenly dispersed as possible. A metal matrix containing only pearlite grains is necessary. This will contain approximately 0.75 per cent combined carbon. The more carbon a metal contains, the more difficult will it be to restrain graphitization. On the other hand when carbon is as low as 2.0 per cent, it is difficult to get any graphite formed at all. The effects of silicon content and cooling rate are known well enough to foundrymen to eliminate discussion on these points. Sulphur retards graphitization as does manganese when it is four or five times the sulphur content. He then discusses Maurer's diagram on the effects of varying silicon and carbon contents. Emmel's process using low carbon and high silicon charges are mentioned as is the process of Corsalli who uses high wrought iron or steel charges with a specially designed cupola for addition of ferroalloys, and a high blast pressure. Included in the other processes mentioned are Piwowarsky's method of super-heating, Dechesne's method of jolting the molten charge, and the Lanz process which uses heated molds.

The author also refers to the use of nickel and chromium in the formation of alloy cast irons. Nickel promotes graphitization similar to silicon except that it forms nodular graphite. It toughens and hardens the pearlite and refines its structure. Nickel makes the metal less sensitive to cooling rate, giving a greater uniformity of structure through thick and thin sections. Chromium retards graphitization. It toughens, hardens and refines the pearlite and reduces the influence of cooling rate. When it is desired to counteract the graphitizing influence of nickel, chromium and nickel may be used together. This is done in the proportion of between 3 and 2 parts of nickel to 1 of chromium. Tough hard-wearing yet machinable cast iron can be produced by this method.

Describes Loam Molding

Loam Molding, by V. Marteil. *Bulletin* of the Association Technique de Fonderie de Paris, January, 1929.

This article reproduces a paper presented by the author before the French association, and gives a comprehensive description of loam molding methods as advocated in France. The first chapter deals with molding in sand with a vertical spindle. Emphasis is laid on the necessity of choosing beforehand which of several possible methods will be adopted for sweeping the mold. The profile of the strickle plate and the order of procedure then will follow. The next chapter deals with the profiles, beveling and making of the strickle plates, their size and sense of rotation. This is followed by a discussion on the preparation of accessory patterns and cores that have to be used in conjunction with loam molding. The article contains descriptions of a number of molds chosen as examples of various cases, together with numerous drawings.

Gives Sand Testing Method

Foundry, Sands, by Gustave Masson and Honore Compere. *Bulletin* of the Syndicate des Foundeurs et de l'Association Technique de Fonderie de Belgique, January, 1929.

The authors have carried on experiments relating to the Gramme method of comparing sands. This method consists in adding 10 cubic centimeters of hydrochloric acid to 10 grams of dry sand in a tube about 0.79 inch in diameter and 19.69 inches high. After having shaken the tube, 10 cubic centimenters of wood spirit are added. The tube is shaken and then about 100 cubic centimeters of water are added, after which the tube is again shaken and left to rest. After 20 minutes the elements of the sand are separated in the following order, starting from the bottom of the tube: Silica, clay, a clear part and a colloidal part. Sands that have given satisfaction may be kept in the tubes and may be used as a basis of comparison when unknown sands are received.

The authors of the present article have found that by making certain modifications in the method of testing, more conclusive results are obtained. Ten grams of dry sand are placed in a container, and 10 cubic centimeters of hydrochloric acid are added. This is stirred, then 25 cubic centimeters of wood spirit is added and stirred again. This is followed by 50 cubic centimeters of boiling water, then the container is covered and the contents are boiled. Then 15 to 20 drops of concentrated nitric acid are added. After boiling a short time, the container and its contents are cooled. The contents are poured into a tube, and water is added to complete 100 cubic centimeters. The tube is shaken for 2½ minutes, and then left to rest for 20 minutes. Measurements then can be made as in the previous case by comparison with sands of a known value that have given satisfactory service in the foundry.

Correlates Test Bars and Design

Design of Engineering Castings in Relation to Tests, by J. G. Pearce, *Foundry Trade Journal*, London, Jan. 24, 1929.

The author compared the results obtained from test bars for the purpose of presenting a more scientific method for calculation in cast iron design. The proposals form a method of treatment only and are not intended for general application. It is necessary for each foundry to determine the relation between strength and section, and strength and composition for its own mixtures if good castings are to be produced.

Conclusions of the author are as follows: Within the gray iron range of cast iron there is a continuous increase in strength as cast iron section diminishes, for tensile, compressive, torsion and transverse tests. The nature of the curve of change depends upon composition and other factors. When the results obtained from the transverse test are interpreted properly by working out transverse rupture stresses, there is a relationship between tensile and transverse tests. For separately cast round test bars the ratio may be taken as 1.8 to 2.0 for transverse divided by tensile, and as 4 for compression divided by tensile. Ratios between other tests should be used with caution until the tests are standardized.

The change in strength with section may be followed conveniently by testing bars of different diameters and from the same melt in transverse. If a series of size-strength curves are prepared for different mixtures, it becomes possible to chart the connection between strength and those elements of composition which usually vary as between different mixtures in the same foundry. Further development on the above lines in foundries working on their own mixtures is likely to provide useful information not only for the designer but also for the foundryman who is interested in the production of good castings free from defects.

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
EDWIN BREMER, Metallurgical Editor
FRANK G. STEINEBACH, Managing Editor
CHARLES VICKERS, Nonferrous Editor
NORMAN F. HINDLE, Assistant Editor

¶ More Apprentices

THE importance attached by the American Foundrymen's association to the subject of training foundry and pattern shop apprentices was indicated at the Chicago convention by the amount of space set aside on the program for consideration of the many phases which this problem presents for solution. For several years the association has looked upon the apprentice question as one worthy of earnest attention and has lent its active assistance to all those engaged in developing programs and conducting educational courses in foundry centers where group activity greatly facilitated the establishment and operation of a fairly well standardized system of training and instruction. Perhaps one of the most important contributions of the association to the training program is its action in preserving in the *Transactions* the many papers and discussions prepared and presented on the subject.

TYPICAL patterns and castings made by apprentices and displayed at the annual convention and exhibition of the association, constitute one of the most effective arguments in creating an apprenticeship consciousness among those who are engaged actively in the conduct of the foundry business. Apprentices from any or all parts of the country may compete under a standard system of regulation that insures equal rights and an impartial judgment. Valuable prizes awarded the winners in the different classes stimulate the boys to greater effort and intrigue the interest of the foundrymen who enter their boys in the race. This style of contest was tried first at the Milwaukee convention in 1924 and has been repeated each year since, with increased interest and a greater number taking part each year.

USUALLY a movement toward the establishment of a training center is the result of many influences and agencies, but in several instances it has been due directly to the work of the American Foundrymen's association. In a typical instance a prominent industrialist attended the apprenticeship session at the Detroit convention in 1926 and became so interested that upon his return home he proceeded to build up in his district what has become an important foundry training center. A feeling seems to be growing that apprenticeship eventually will solve the personnel problem in the foundry.

¶ Pig Iron Measures Business

PIG iron and ferroalloy production in the United States for the year 1928 was 38,155,714 tons as compared with 36,565,645 for 1927, an increase in the total of 4.35 per cent, according to statistics compiled by the American Iron and Steel institute. Of this amount 37,401,648 tons was pig iron and 754,066 tons, ferroalloys. Pig iron tonnage increased 4.30 per cent and ferroalloy production increased 6.59 per cent. The tonnage of merchant pig iron was 7,723,676 tons and 580,293 tons of ferroalloys were offered for sale. Foundry pig iron constituted 11.26 per cent of the total production or 4,209,790 tons, a decrease of 1,294,629 tons or 23.52 per cent as compared with 1927 total. Malleable pig iron produced was 1,922,970 tons. This amounted to 5.14 per cent of the total production and represented an increase of 223,387 tons or 13.14 per cent over the 1927 figures.

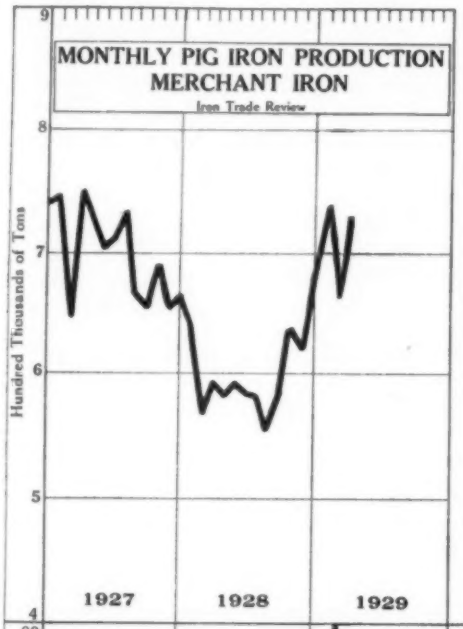
WHAT do these figures mean? Does the decrease in the production of foundry pig iron mean that the gray iron foundry business was poor last year? Not necessarily. Gray iron foundries enjoyed a fairly good business in 1928. The decrease in foundry pig iron production then must be due to some other cause. It easily might be attributed to the fact that there has been a tendency to use more scrap of late than formerly or that foundries were buying on a hand-to-mouth basis and in some cases they used from stock. Malleable foundries enjoyed better business last year than in 1927 and the increase in the production of malleable pig iron may be attributed to this reason, supplemented by the malleable grades melted by gray iron foundries.

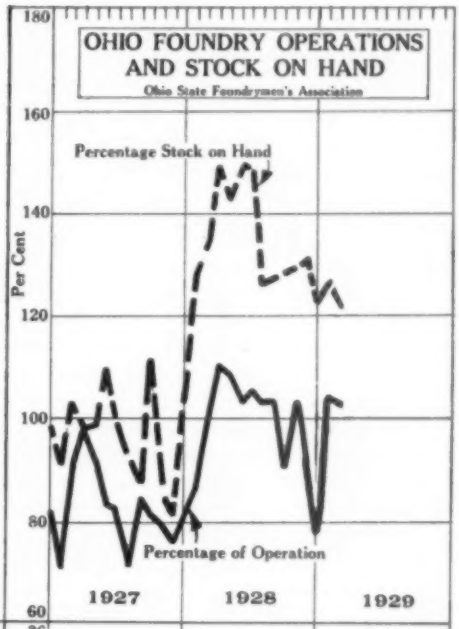
Trade Trends in Tabloid

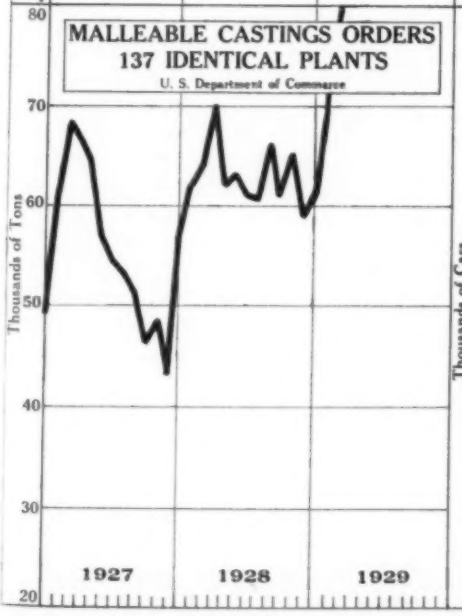
FOUNDRY business continues to improve. Practically all lines of castings manufacture are engaged from 75 to 85 per cent of capacity. Railway buying supported by March purchases of more than 12,000 units bringing the first quarter demand to more than 21,000 cars, is bringing new castings business to steel and malleable foundries. Automobile production for March probably will range above February, which with a total of 497,371 cars, surpassed all previous records. Many large automobile plants operating their own foundries are jobbing large tonnages of castings. Cast-iron pipe buying is picking up. Building awards are increasing. Stove and furnace, radiator and sanitary ware foundries are extremely active. Nonferrous foundries, particularly those in the automotive field, are active. The pig iron output for March with a total of 3,706,822 tons compared with 3,218,376 tons broke all records for March. The daily average rate, according to *Iron Trade Review*, was 119,575 tons, exceeding the previous high March, 1925, by 3.7 per cent. Merchant iron production totaled 728,948 tons. Average New York prices on nonferrous metals for March, as compiled by *Daily Metal Trade*, follow: Casting copper, 21.202c; electrolytic copper, 21.476c; Straits tin, 48.888c; lead, 7.493c; antimony, 9.498c; aluminum, 23.90c. Zinc averaged 6.474c, E. St. Louis, Ill.

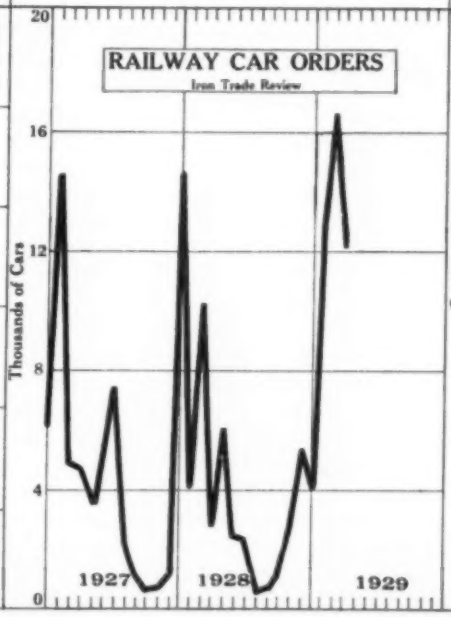
RAW MATERIAL PRICES
April 4, 1929

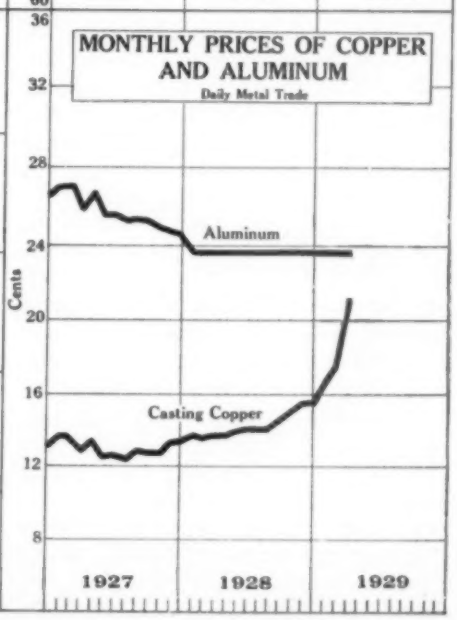
Iron	
No. 2 foundry, Valley	$18.00
No. 2 southern, Birmingham	15.50 to 16.50
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	17.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry coke	$3.75 to 4.85
Wise county foundry coke	4.25 to 5.00
Scrap	
Heavy melting steel, Valley	$18.00 to 18.25
Heavy melting steel, Pitts.	18.00 to 19.00
Heavy melting steel, Chicago	15.75 to 16.25
Stove plate, Buffalo	14.25 to 14.75
Stove plate, Chicago	12.75 to 13.25
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	16.00 to 16.50
No. 1 cast, Philadelphia	16.00 to 17.00
No. 1 cast, Pittsburgh	15.50 to 16.00
No. 1 cast, Birmingham	14.00 to 15.50
Car wheels, iron, Pittsburgh	16.25 to 16.75
Car wheels, iron, Chicago	14.50 to 15.00
Railroad malleable, Chicago	19.00 to 19.50
Agricultural mal., Chicago	15.50 to 16.00
Malleable, Buffalo	18.00 to 18.50
Nonferrous Metals	Cents per pound
Casting, copper, refinery	23.75
Electro, copper, producers	24.00
Straits tin	48.12½
Lead, New York	7.50
Antimony, New York	9.62½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.80











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

STANLEY B. DeLONG, formerly vice president in charge of operations, American Radiator Co., New York, has been elected president of Pierce, Butler & Pierce, 41 East Forty-second street, New York. He succeeds Roger Morton. The Pierce company operates plants at Syracuse, N. Y., Huntington, Pa., Zanesville, O., and the Ames Iron Works, Oswego, N. Y.

George R. Hann has been elected a director of Mackintosh-Hemphill Co., Pittsburgh. He succeeds John Chalfant, resigned.

W. J. Miller, formerly president of the Northwestern Steel & Iron Co., Minneapolis, has been appointed vice president of the Foote Bros. Gear & Machine Co., Chicago.

Maxwell A. Coe, formerly superintendent of the Stanley Rule & Level Co., subsidiary of the Stanley Works, New Britain, Conn., recently was made manager.

E. R. Bishop, general manager, Globe Forge & Foundries Inc., Syracuse, N. Y., has been elected vice president and treasurer. He also was made a director.

Charles F. Treadway, treasurer of the Peck, Stow & Wilcox Co., Southington, Conn., recently was elected secretary and treasurer. He succeeds F. D. Taylor, resigned.

J. R. Small, formerly at the Indiana Harbor, Ind., plant of the American Steel Foundries, has been appointed melter at the Alliance, O., plant of the company.

John Flynn, for 15 years superintendent of Williams Foundry & Machine Co., Akron, O., recently acquired by the National Foundry Co., Erie, Pa., has become affiliated with Franz Foundry & Machine Co., Barberton, O.

A. Fries, formerly plant manager, Peru Foundry Co., Peru, Ind., was made vice president and general manager at a recent meeting of the stockholders and directorate at Dayton, O. He succeeds P. V. Gartland, of Indianapolis.

Howard H. Talbot has been appointed chief engineer of the United Engineering & Foundry Co., Pittsburgh, succeeding the late Lane Johnson. Mr. Talbot joined the United Engineering company in 1923, having previously been connected with the Mackintosh-Hemphill Co. as chief engineer at the Woodward Machine Co. department, Wooster, O., and prior to that was engineer for the William Tod Co., Youngstown, O., and the Connecticut Co., New Haven, Conn. He is a graduate of Beloit college, Beloit, Wis., and Case School of Applied Science, Cleveland.

W. H. Milliken has been elected president of the Charleroi Iron Works, Charleroi, Pa. Other officers are: Vice president and general manager, C. B. Anfindsen; vice president, J. M. Hennegan; and secretary-treasurer, John D. Berryman.

O. B. Stauffer, formerly sales manager, Forest City Structural Steel Co., Cleveland, has been appointed manager of the architectural department of the John Harsch Bronze & Foundry Co., Madison avenue and West 116 street, Cleveland.

Dr. Richard Moldenke, Watchung, N. J., recently returned from a three weeks' visit to the foundries in the South. He addressed the foundrymen of Birmingham, Ala., and Chattanooga, Tenn., as guest of the Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.

Thomas S. Gates, formerly chairman both of the board of directors and of the executive committee, of the Baldwin Locomotive Works, Philadelphia, has been elected chairman of the executive committee. Mr. Gates is a member of the firm Drexel & Co., Philadelphia and of Morgan & Co., New York.

Samuel M. Vauclain, formerly president of the Baldwin Locomotive Works, Philadelphia, has been elected chairman of the board of directors. Mr. Vauclain has served as president since May, 1919, and it was during that time that the company built its new works at Eddystone, Pa., and removed all of the company's activities from the old plant in Philadelphia to Eddystone.

Michael J. Froloff, superintendent, Putillov plant, Leingrad, and A. A. Ribakoff, Stalingrad, Russia, are touring America studying American foundry practice, plant arrangement, and equipment. Mr. Froloff is in charge of the construction of a large new gray iron foundry which will be built under the direction of Frank D. Chase, Inc., Chicago. He is purchasing complete equipment and expects to engage the services of two or three American foundrymen to assist in starting operations.

Paul E. McKinney, formerly chemist and metallurgist for the United States naval gun factory, Washington, has resigned and has been appointed metallurgical engineer for the Bethlehem Steel Co., Bethlehem, Pa. For many years he was in charge of the foundry at the naval gun factory and is widely known for his work with high strength castings both in steel and bronze.

George H. Houston has been elected president of the Baldwin Locomotive Works, Philadelphia, succeeding Samuel M. Vauclain. Mr. Houston is an associate of the Fisher brothers of Detroit. His connection with the Baldwin company began in January when he became a member of the board of directors as representative of the Fisher interests.

L. E. Gulliford, formerly general superintendent McMyler-Interstate Co., Cleveland, recently has become associated with the Pulaski Foundry & Mfg. Corp., Pulaski, Va., as general manager. Prior to his association with the McMyler-Interstate, he was connected with Brown Hoisting Machinery Co., Cleveland; Wellman Seaver Morgan Co., Cleveland; McClintock Marshall Co., Pittsburgh; and the King Bridge Co., Cleveland.

Russell B. Koontz, former secretary and treasurer of the Adamson Machine Co., Akron, O., has been elected president to succeed the late Alexander Adamson. C. F. Adamson, son of the late executive, has been elected vice president and Carl L. Fenn succeeds Koontz as secretary and treasurer. W. E. Slabaugh, of a prominent Akron law firm, has been elected to fill Adamson's place on the board of directors.

D. C. Lloyd, joint managing director, F. H. Lloyd & Co., Ltd., James Bridge Steel Works, Wednesbury, England, accompanied by his son, F. N. Lloyd, and H. L. Turner of the same firm, are touring America studying American foundry equipment and methods. They spent the week of April 8 in Chicago at the American Foundrymen's association convention. They left soon after the close of the convention for their home.

Publishes Booklet

The Sivyer Steel Casting Co., Milwaukee, recently celebrated the twentieth anniversary of the pouring of the first heat in the foundry of the company. In commemoration of this event that company issued a booklet entitled "Dependability in Steel Castings." The booklet takes the reader through the various steps in the manufacture of steel castings. It explains many of the control features of a steel foundry and gives some of the precautions necessary for the production of good castings. The publication is illustrated with pictures from the various departments, micrographs and charts. Included is a reproduction of a temperature control chart taken from an annealing furnace.

To Have Slogan Contest

The National Electrical Mfg. association and the National Electric Light association are giving seven prizes totaling $500 for the best slogans to promote the use of electric heat in industry. Each contestant may submit not more than three slogans and each must be accompanied by an analysis not exceeding 100 words. Preference will be given to brevity. Contestants should submit each slogan and its accompanying analysis on a separate sheet of paper. The entry name should appear only on the outside of the envelope which should be addressed to the NEMA-NELA Slogan Contest, National Electrical Mfg. association, 420 Lexington avenue, New York. All slogans must be in the mails before midnight May 30.

Publishes Standards

A new edition of the standards of the Hydraulic society, 90 West street, New York, just has been published. This booklet gives the principles of business conduct approved by the society, definitions and values, test codes, classification of pumps of various types, instructions for installation and operation of pumps, and data, tables and curves relating to pumps. The booklet may be obtained from C. H. Rohrbach, secretary, at the previously mentioned address for 50 cents.

Changes Personnel

American Dressler Tunnel Kiln Co., Cleveland, recently elected the following officers, John F. Casey, chairman of the board; Philip Dressler, president; L. A. Vincent, vice president; R. E. Whittaker, secretary, and Paul Meehan, treasurer.

National Safety Council To Meet in Chicago

According to W. H. Cameron, managing director, National Safety council, 108 East Ohio street, Chicago, the eighteenth annual safety congress will be held in Chicago, Sept. 30 to Oct. 5 inclusive. While general headquarters will be established at the Stevens hotel, the Blackstone and Congress hotels also have been designated as convention hotels. During the six days of this congress approximately 150 sessions will be held in the three hotels. It is predicted that 7000 safety workers of America and other countries will be present at the convention.

Study Chromium Plating

Recently the department of engineering research, University of Michigan, Ann Arbor, Mich., published a bulletin by Richard Schneidewind on a study of chromium plating. Experimetal work done in the course of the investigation gave data on obtaining smooth, bright plates; low rate of anode corrosion and low trivalent chromium concentration. Copies of the bulletin which is No. 10 may be secured from the engineering research department, University of Michigan, for the price of $1.

Foundry Association Directory

American Foundrymen's Association

President, S. T. JOHNSTON, S. Obermayer Co., Chicago; secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, J. A. DUNCAN, Wm. Duncan & Sons Co., 166 Liverpool street, East Boston, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, DAVID G. ANDERSON, Western Electric Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, 25 Woodrow street, West Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, 5502 Ivanhoe, Detroit. Meetings third Thursday in each month at appointed place.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; Secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, F. L. SIVYER, Rockford-Northwestern Malleable Corp., Rockford, Ill.; secretary, ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smead avenue, Toledo, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association

President, W. P. BRADLEY, Wheeling Mold & Foundry Co.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, A. D. MATHESON, French & Hecht, Davenport, Iowa; secretary-treasurer, HUGO WOLF, Frank Foundries Corp., Davenport, Iowa. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY. Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, A. G. WESSLING, Wessling Bros. Foundry Co., 1607 McLean avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, WILLIAM E. LOBERG, American Hoist & Derrick Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Obituary

Albert Pankow, pioneer foundryman of Sioux Falls, S. Dak., died recently at Long Beach, Calif., where he had gone to spend the winter. He was 69 years of age. Mr. Pankow was one of three brothers who started Pankow Bros., a foundry and machine business in 1884 in Sioux Falls. He had retired from active business in 1916.

William G. Harris, vice president and general manager, Canada Metal Co., Toronto, Ont., died at his home in that city on March 28. He was the founder of the metal company, and under his guidance the company has grown so that it now occupies a five-acre plant.

Frederick Leslie Dudley, aged 71, for many years chief engineer of the American Bridge Co. plant at Ambridge, Pa., died March 27.

Describes Exhibit

Recently the Aluminum-Beratungsstelle, Berlin, Germany, published a 36-page catalog describing its permanent exhibit at Lautawerk, of aluminum from raw products to finished materials. The exhibit was arranged by 54 German firms which compose the membership of the association. The display comprises 25 different groups containing 2500 specimens, giving information on the physical and technical properties of aluminum and its alloys.

Gives Clay Consumption

The number of tons of clay used in the foundries and steel works for the year 1927 was 482,104 as compared with 523,660 tons in 1926, according to a bulletin of the department of commerce. This is a decrease of 41,556 tons or a decrease of 7.7 per cent.

Will Need Castings

An enormous tonnage of cast segments will be required for the proposed vehicular tunnel to be erected by the board of transportation under the Narrows, between Brooklyn and Staten Island. While some trade interests estimate 125,000 tons, others regard this as extremely conservative and place the requirements at 150,000 to 175,000 tons, and should the larger of the two proposed routes be decided upon, it is believed that the requirements will be even heavier. It appears the work will require more castings than the Holland vehicular tunnel which called for approximately 110,000 tons of gray iron segments and 10,000 tons of segments made of cast steel.

Elected Vice President of Link-Belt

James S. Watson has been elected vice president of the Link-Belt Co., Chicago. Mr. Watson, a native of Philadelphia, has been with Link-Belt Co. continuously for 34 years, having entered the employ of its

JAMES S. WATSON

Philadelphia plant when a boy. In January, 1903, after eight years' experience in various departments, the management placed him in charge of the sales of its silent chain products which were introduced in 1900. For the past nine years Mr. Watson has been general manager of the company's Dodge works in Indianapolis. In that capacity he has had charge of production and sales of silent and roller chain drives and the sale of herringbone speed reducers and other products. Mr. Watson's headquarters will continue to be at the company's Dodge works in Indianapolis.

Sells Dust Arresters

The Northern Blower Co., Cleveland, has sold dust arrester equipment to the Cloyes Gear Works, East Cleveland, O., the Forest City-Walworth Run Foundries Co., Cleveland, and the Republic Brass Co., Cleveland.

Is Elected Treasurer

Henry W. Armstrong, formerly assistant treasurer, Joseph Dixon Crucible Co., Jersey City, N. J., has been elected treasurer of the company. Mr. Armstrong was born in Jersey City and began his career as office boy for the Dixon company in 1903, He later served in the export and sales departments. In 1920, he was appointed credit manager and in 1926 was elected assistant treasurer of the company. Mr. Armstrong is a member of several credit men's associations including the national organization. He has served on many committees of that organization including a special committee for the revision of its manual of commercial laws.

Elect Standart Chairman

H. W. Standart, Northern Engineering works, Detroit, was elected chairman of the Hoist Manufacturers association at the annual meeting held in New York. J. G. Worker, American Engineering Co., Philadelphia, was made vice chairman. The next meeting of the association will be held in New York, May 16.

Receives Promotion

R. A. Shilbauer, for the past several years assistant advertising manager of the Chain Belt Co., Milwaukee, has been promoted to advertising manager. Mr. Shilbauer joined the Chain Belt Co. in 1920 as rate setter and worked in that capacity in the various departments of the company's gray iron foundry and chain assembly plants on Park street, Milwaukee. He later was transferred to the company's West Milwaukee plant. In 1925 he was placed in the advertising department and later became assistant advertising manager.

Gives Molding Sand Data

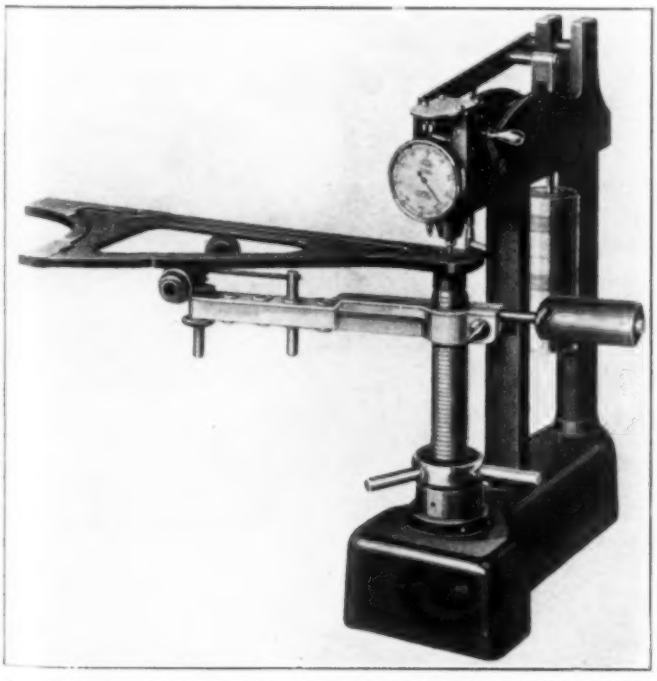
The production of molding sand decreased 21 per cent in both quantity and value in 1927 as compared with 1926, according to data issued by the department of commerce. The value of the 5,309,371 tons of molding sand produced in 1926 was $5,630,799 while in 1927 only 4,194,975 tons were produced valued at $4,458,508. The average price per ton for both years was the same, $1.06. The report included statistics assembled from 32 states. Those leading in the production of molding sand in their order of tons mined are: Ohio, Illinois, New York, Michigan, Pennsylvania, New Jersey and Indiana.

Publish Bulletin

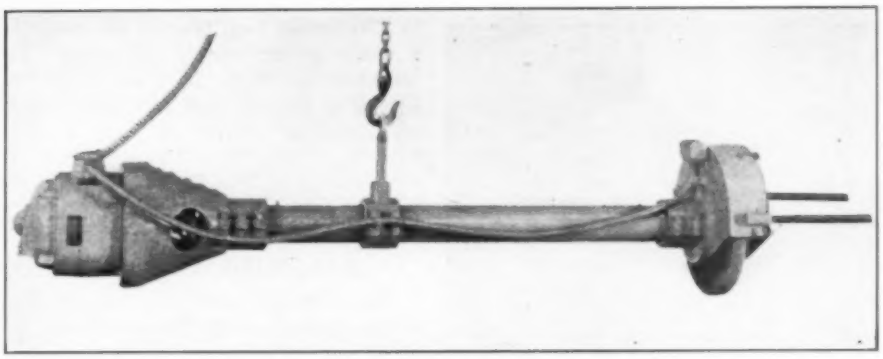
University of Illinois has issued its bulletin No. 187 on the determination of the capillary constant of silver. The bulletin gives the principles underlying the determination, reviews the previous work done on the subject and describes the theories and methods of investigation. An outline of the apparatus used also is given. The latter part of the book is devoted to tables of calculations.

Improves Test Machine

The Wilson-Maeulen Co., Inc., 383 Concord avenue, New York, recently has introduced a new rest attachment for its Rockwell type hardness tester. Pieces to be tested often need additional support if they are elongated or unbalanced where they rest upon the anvil. When these pieces are both long and heavy, an adjustable jack support is recommended. However, where the pieces are of only moderate weight and length, the new rest attachment shown in the accompanying illustration may be used to advantage. This rest is designed for supporting a variety of shapes and sizes. The vise is constructed to support the piece being tested so that it will not slip, roll or shift during the application and withdrawal of the minor and major loads, especially the major load. Failure to support an overhanging, unbalanced piece, may break the diamond or result in an inaccurate test. The new rest increases both the ease with which the test is made and its value with regard to accuracy.



THE SUPPORT MAY BE ADJUSTED UNTIL THE SPECIMEN RESTS EVENLY ON THE ANVIL OF THE TESTER



THE WHEEL RUNS AT RIGHT ANGLES TO THE FRAME

This support permits adjustment until the piece being tested rests solidly and firmly upon the anvil of the tester. The arm is of aluminum and an adjustable counterbalance is provided. In using the rest, the wing screw which clamps the frame to the elevating screw of the tester, is loosened and the frame is raised or lowered to bring it approximately to its proper position. The hand wheel then is turned to carry the piece up against the penetrator for contact and for application of the minor load. The anvil, the piece to be tested and the support all are elevated together and are undisturbed in relation to each other.

Swing Frame Grinder Is Direct Connected

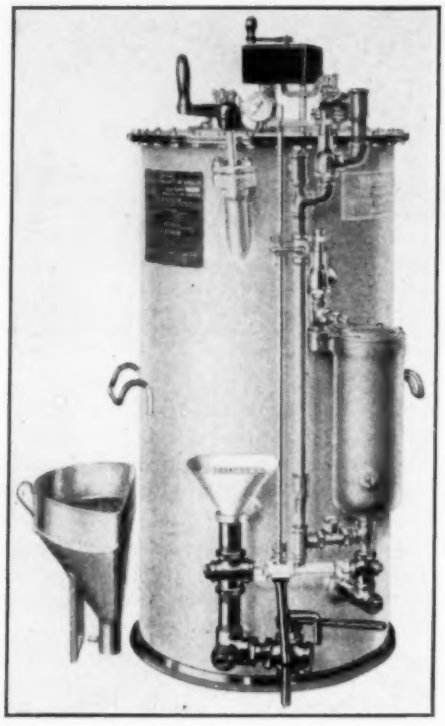
The Kinney Iron Works, Santa Fe avenue at Twenty-eighth street, Los Angeles, has developed a new swing frame grinder designed especially for snagging cast iron and steel, grinding rails and frogs, etc. The features claimed for the equipment include simplicity of design and ruggedness to permit a low upkeep cost. The motor is connected directly to the wheel through a flexible coupling and heavy shaft. Both ends of the shaft are mounted on heavy dust-sealed ball bearings. The motor also is provided with dustproof ball bearings. The wheel runs at right angles to the frame, as may be noted in the accompanying illustration. The wheel guard may be rotated easily so that either side of the wheel is exposed. The grinder is suspended on a sliding collar which permits adjustment for balance as the wheel wears. With a 5-horsepower motor, the maximum wheel size is 18 x 3 inches and with a 10-horsepower motor, the maximum is 24 x 3 inches.

Makes Cast Iron Pipe in 18-Foot Lengths

In the early days of the manufacture of cast iron pipe the individual lengths commonly produced were from 2 to 4 feet long. As the industry developed these lengths were increased to 9 feet, 12 feet, and in 1914, 16-foot lengths were produced. According to the *Cast Iron Piper*, a magazine published by the United States Cast Iron Pipe & Foundry Co., Burlington, N. J., that company is making pipe in 18-foot lengths by the deLavaud centrifugal casting method. Numerous advantages are claimed for the longer pipe, such as a decrease in the quantity of jointing materials required, couplings, connecting pieces, etc., and a corresponding decrease in the amount of labor involved. The difference in length does not affect the weight materially and hence no more men are required to handle the longer pipe.

Buyers To Meet in June

The fourteenth annual meeting of the National Association of Purchasing Agents will be held at the Hotel Statler, Buffalo, June 3-6. The buyers will study commodity trends, business conditions, purchasing practices, new sources of supply, new services and new products. The program calls for general sessions and meetings for individual groups. An exhibit to be held in conjunction with the convention, will feature industrial equipment, services and improved products. It will be of an informative nature to the up-to-date purchasing agent.



SAFETY FEATURES ARE INCLUDED IN THE DESIGN OF THE UNIT

Charger Operates in a Small Shop

Edgar E. Brosius, Inc., Pittsburgh, recently has developed a floor charging machine for open-hearth furnaces, cupolas, etc. The accompanying illustration shows the machine handling a charging box for a 15-ton open-hearth furnace. The machine is designed to operate in a small floor space. The tractor wheel is driven through spur gears by a motor mounted on the tractor. The machine is steered through a pair of bevel gears by a standard automobile truck steering wheel. The tractor is mounted on a vertical shaft supported by roller bearings and can turn at right angles, thus allowing a charger to turn on its own wheel base. The front wheels are equipped with roller bearings and all wheels are provided with rubber tires. The peel is tilted and rotated by hydraulic cylinders actuated by a motor-driven rotary oil pump. The machine is built in two sizes designed to handle 2000 and 4000 pounds respectively.

Generator Operates at Medium Pressure

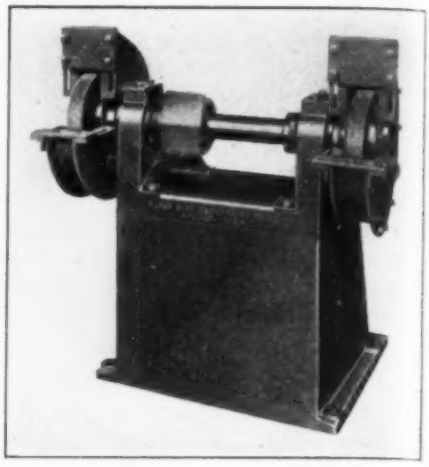
The Oxweld Acetylene Co., 30 East Forty-second street, New York, has developed a medium pressure acetylene generator which may be used with either medium-pressure or low-pressure welding and cutting blowpipes. Safety, dependability, sturdiness and minimum pressure fluctuation during operation are some of the features claimed for this generator.

Heavy gage material is used in the construction of the generator and, where strength is required of the fittings, steel castings have been used. Bronze welding has been used for joining the generator shell and fittings.

The carbide valve is rotated by a spring clock motor which is governed by diaphragm type motor feed control. Pressure adjustment is made easily by a thumbscrew on the motor feed control. Fluctuation during normal operation is less than 1 pound per square inch and even under severe load the carbide feed is regulated to limit after-generation to a maximum increase of 1 pound per square inch.

Should, by any chance, both the motor brake and relief valves fail to function, the motor locks at about 18 pounds per square inch pressure, thereby stopping the carbide feed. Should a broken line or leak of any kind cause the pressure to drop to zero during operation, the motor stops and will not start except by hand. The motor is enclosed in a dust-tight housing. Time required for shutting down the generator, flushing and refilling with carbide and water is about 15 minutes.

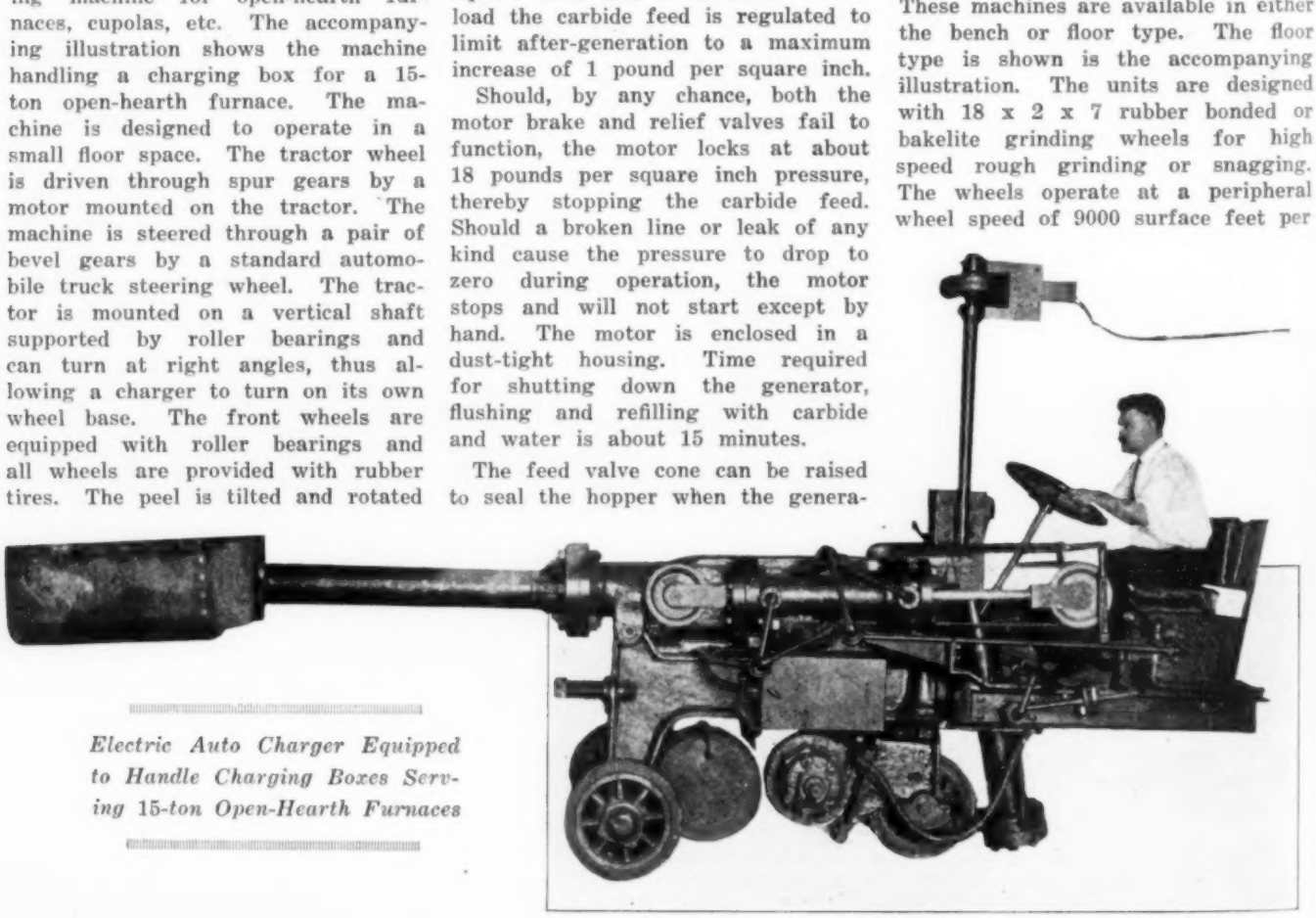
The feed valve cone can be raised to seal the hopper when the generator is being removed. This valve also is raised automatically, closing the hopper, every time the carbide filling door is opened. The hopper and generator body are so designed that no water will enter the hopper in case the generator is knocked over.



THE MACHINE IS MADE IN EITHER THE FLOOR OR THE BENCH TYPE

Grinder Is Built for High Speeds

Kling Bros. Engineering Works, 1300 North Kostner avenue, Chicago, recently introduced a new line of small grinders of the high speed type. These machines are available in either the bench or floor type. The floor type is shown is the accompanying illustration. The units are designed with 18 x 2 x 7 rubber bonded or bakelite grinding wheels for high speed rough grinding or snagging. The wheels operate at a peripheral wheel speed of 9000 surface feet per



Electric Auto Charger Equipped to Handle Charging Boxes Serving 15-ton Open-Hearth Furnaces

SHOES ARE EQUIPPED WITH SPECIALLY DESIGNED FASTENERS

minute or 1910 resolutions per minute.

The grinders are constructed with a cast semisteel frame. Wheel shafts are finished all over and fitted with double row radial ball bearings. Chucks are cast steel and are balanced carefully. Bearings are enclosed fully to prevent the entrance of dust and dirt. A rubber covered pulley drive is provided to avoid slippage. Several of the features claimed for this machine include quick grinding, maximum wheel efficiency and low cost per pound of metal ground.

Shoes Protect Workers

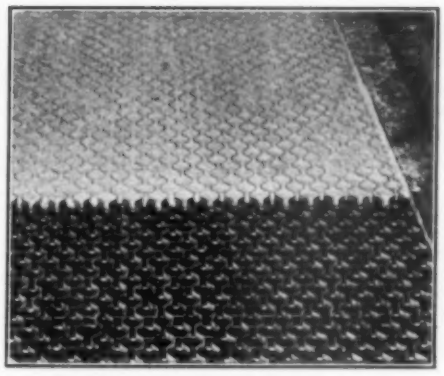
The Rohrbacher Shoe Co., 60 South street, Boston, recently developed a new type of safety shoe designed primarily for the foundry and other industrial workers. Shoes of this type are equipped with special fasteners which make them easy to put on and quick to get off, a heat-resisting all leather upper, and a fireproof composition sole. They also are practically waterproof. A special type of toe lessens danger of injury from falling tools and other materials. The fasteners lock on three sides and are opened on the fourth, thus insuring a constantly locked shoe which may be removed easily with one wayward pull. The shoes are so designed that no material, such as sand or hot metal can seep into the shoe and burn the foot. The type of fastener used is shown in the accompanying illustration.

Steel Mat Strengthens Concrete Floor

Blaw-Knox Co., Pittsburgh, recently has introduced a new material for steel-armoring concrete, asphalt and composition floors. This armoring is designed to increase the strength of the floor material. The material is a built up continuous steel mat which is laid down to form the surface of the floor. It is claimed that the pattern which is made, has been designed scientifically to present a surface in which the steel will care for the stresses caused by heavy traffic.

Drawings and special tools are not required to lay the floor. The material consists of a number of steel strips shaped into a regular pattern which, when placed together, form a series of separate rectangular blocks. Small, short circular tie rods are inserted in a horizontal position through holes in the middle of the strips. These tie rods act as carrying members and also tie the entire surface into one steel mat.

Small steel lugs are placed between adjacent strips at the points where the tie rods go through the steel strips. These lugs act as anchors to hold the steel strips in the plastic material. The floor is made in various sizes of mesh to conform with the various conditions such as size of truck wheels, weights of loads and types of traffic.



STRIPS ARE SHAPED TO FORM A REGULAR PATTERN

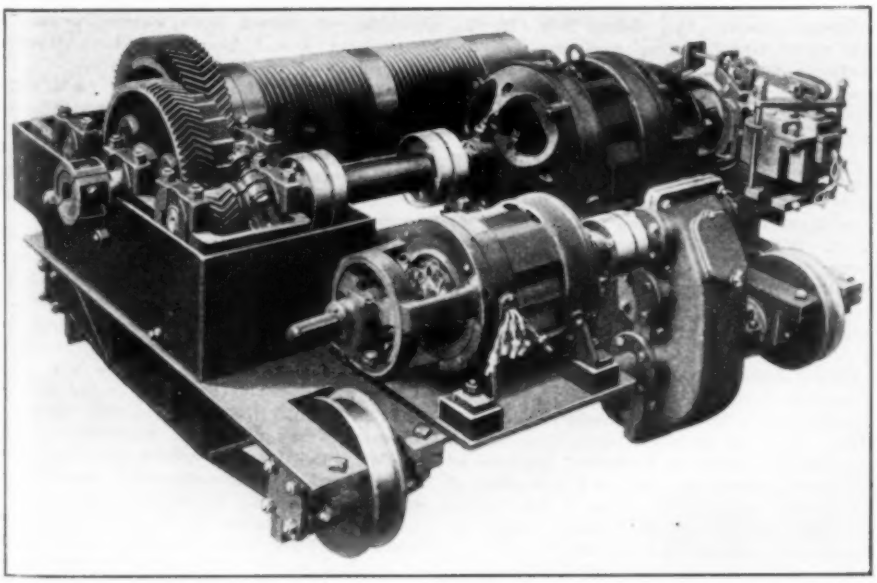
Traveling Crane Has Herringbone Gears

Whiting Corp., Harvey, Ill., recently has introduced a new type of crane designed especially to speed material handling operations. One of the principal features of the new crane is the use of herringbone gears. It is claimed that a smooth rolling action is obtained with that type of gear thus reducing friction and increasing the life of the gear. The crane also is equipped with roller bearings made by the Hyatt Roller Bearing Co., Detroit.

Special attention has been given to lubricating problems on the crane. The entire hoisting mechanism, including mechanical brake and drum gear, is enclosed in an oil-tight steel casing. The entire unit operates in an oil bath, as does the bridge drive gearing. Axle and squaring shaft bearings are lubricated by a high pressure grease gun.

Special safety features have been included in the crane design. A broad footwalk with upturned sides extends the length of the crane on the driving side. All gears are enclosed which prevents the possibility of accidents while the crane is being inspected or repaired. Other safety features include automatic brakes, automatic limiting device to prevent over-travel of the hook, a fully enclosed switchboard with suitable locking device, rail guards for the wheels, etc.

All parts of the crane are machined to jigs and dies, making them interchangeable. The use of herringbone gears has made it profitable to secure the necessary speed with two gear reductions. An illustration showing the herringbone gears with the cover removed appears at the left.



TROLLEY MECHANISM OF THE TRAVELING CRANE WITH THE GEAR COVER REMOVED

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Crown Pattern Works has removed from Pasadena, Calif., to 1106 Meridian avenue, Alhambra, Calif.

The Hubley Mfg. Co., Lancaster, Pa., manufacturer of cast iron toys, is preparing plans for the erection of a foundry addition.

L. H. Goodnow Foundry Co., Fitchburg, Mass., recently was damaged by fire. New equipment probably will be purchased.

Federal Mogul Corp., Detroit, has let the contract for the construction of a foundry building to Austin Co. (Noted April 1.)

Kimball Bros. Elevator Co., Omaha, Nebr., plans improvements to its new foundry at 1020 South Ninth street.

Arcade Malleable Iron Co., Worcester, Mass., is erecting a one story addition 43 x 75 feet, to its foundry.

National Foundry Co., Erie, Pa., will begin enlargements to its plant immediately. A machine shop, 145 x 340 feet, will be erected.

Decatur Castings Co., Decatur, Ind., has leased the foundry department of the Decatur Foundry, Furnace & Machine Co., Decatur, Ind.

Dearborn Foundry Co., Chicago, has increased its stock and has increased the number of directors from three to five.

American Machine & Foundry Co., Second avenue and Fifty-sixth street, Brooklyn, has purchased the plant and business of American Oven & Machine Co., 615 South California avenue, Chicago.

Intercontinental Pipe & Mining Co., Chelsea, Mass., plans to begin the construction of a foundry for the manufacture of cast iron pipe in about 60 days.

Western Steel & Foundry Co., Midvale, Utah, W. L. Booth, president and general manager, contemplates the construction of foundry improvements and additions.

Neal Lucey Co., 60 North Hamilton street, Houston, Tex., is completing plans for a new machine shop and foundry to be erected on Greenwood street. Neal Lucey is president.

Acme Aluminum Foundry Co., Chicago, 814 West Seventy-fifth street, plans the construction of a 2-story foundry and office addition, 50 x 125 feet.

Twin City Foundry Co., Aberdeen, Wash., has been incorporated with $20,000 capital by Grays Harbor Welding & Boiler Shop, South F street.

Henry Lindahl Foundry & Machine Co. is the new name adopted by the former Henry Lindahl Machine Co., Chicago, manufacturer of gray iron and semisteel castings.

Texas Brass & Mfg. Co., 1404 Elysian avenue, Houston, Tex., will build a machine shop, 40 x 100 feet, and will enlarge its foundry. D. D. Daugherty is manager.

Springfield Bronze Co., Springfield, Mass., is to build an addition to its plant at East Springfield, Mass., and will install additional oven equipment.

The Segal Lock & Hardware Co., 55 Ferris street, Brooklyn, has awarded a contract to Lockwood, Green & Co. for the erection of an iron foundry on property adjoining its main plant.

Stearman Aircraft Co., 601 East Thirty-fifth street, Wichita, Kan., has awarded a general contract to the Henrion Improvement Co., Schweiter building, for a one-story and basement foundry addition, 55 x 125 feet. The building and equipment will cost about $30,000.

Alfred W. Grabo Co., 609 West Lake street, Chicago, has been incorporated with $4000 capital by Leo Lichtenstein to engage in engineering and designing business, tool making, brass founder, etc.

Piston Ring Co., Muskegon, Mich., is planning to increase its plant and productive capacity about 50 per cent. Its customers include the Ford Motor Co. and Chevrolet Motor Car Co.

Eureka Planer Co., Winnett street, Woodstock, Ont., has awarded contract to James Vance, Market square, for the erection of a 1-story addition to No. 3 foundry on Tecumseh street.

Super Health & Foundry Co. Ltd., Toronto, Ont., has been incorporated to carry on a general foundry and pattern business with $40,000 capital by Chalmer H. Weir, Lorna M. Parker and Daisy Morsman, all of Toronto.

De Laval Separator Co., Poughkeepsie, N. Y., will take bids in about 30 days for one and two-story foundry additions. The buildings and equipment will cost more than $130,000. S. H. Chadwick, 140 Cedar street, New York, is the consulting engineer.

Bovee Furnace Works, 180 Eighth street, Waterloo, Ia., has been sold to Barnett Schultz. The transaction includes all real estate, buildings, stocks, equipment, fixtures, patterns and tools owned by the company. The firm will continue to operate under the same name.

Cartersville Foundry & Machine Co., Cartersville, Ga., John W. Jackson manager, plans to move its plant to a site south of town where it will erect two buildings for a machine shop and foundry. The foundry will be equipped with machinery for making soil pipe.

Robert Mitchell Co. Ltd., 750 Blair street, Montreal, Que., is having plans drawn for a new foundry, one-story, 200 x 600 feet, to be located at St. Laurent, Que. T. Pringle & Sons Ltd., 410 St. Nicholas street, St. Laurent. Que., is preparing the plans.

Buda Co., Harvey, Ill., has awarded the contract for the construction of an addition to its Halsted street foundry to Austin Co., 16112 Euclid avenue, Cleveland. The building will be a 1-story cleaning house for the foundry, 60 x 100 feet.

General Electric Co., Schenectady, N. Y., will move manufacturing operations of its Baltimore plant to Philadelphia, leaving the brass foundry in operation at Baltimore. The plant will be available for use whenever necessary.

Cooper-Bessemer Co., has been formed by the merger of the Bessemer Gas Engine Co., Grove City, Pa., and the C. & G. Cooper Co. with plants at Mount Vernon and Hamilton, O. B. B. Williams, formerly president of the Cooper company, is president of the new consolidation and Dr. E. J. Fithian, formerly president of the Bessemer company will be chairman of the board of directors. (Noted Feb. 15.)

Yates-American Machine Co. has consolidated operations of its Williamsport, Pa., and Montgomery Pa., plants with Rochester, N. Y., Beloit, Wis., and Hamilton, Ont., Can., plants. The board of directors authorized the sale of real estate, machinery, tools and equipment of the former plants at a public auction which was held April 9 and 10. Several pieces of foundry equipment were included.

Crompton & Knowles Loom Works, Worcester, Mass., has elected the following officers: President, Homer Gage; vice presidents, John F. Tinsley, Frederick W. Howe and Irving H. Verry; general manager, John F. Tinsley; treasurer, Edward F. Green; assistant treasurer, Fred J. Bowen; clerk, John B. Syme. Directors include the officers and S. B. Alexander, George Crompton, Thomas H. Gage, Albert A. Gordon, Frank P. Knowles, Henry F. Phelps, Pierpont L. Stackpole, Charles M. Thayer and George E. Warren.

American Radiator Co., New York, and Standard Sanitary Mfg. Co., Pittsburgh, have completed their merger by the incorporation in Delaware of the American Radiator & Standard Sanitary Corp. Clarence M. Wooley, chairman of the board of American Radiator, has been elected to the same post in the new company, with Theodore Ahrens, president of Standard Sanitary, as president; Charles L. Hodges, American Radiator, vice president; Rolland J. Hamilton, secretary and treasurer, and Henry L. Weimer, assistant treasurer.

Cadillac Motor Car Co., Detroit, has awarded the general contract for the construction of a 1 and 4-story building to Martin-Krausman Co. The Cadillac company plans to spend $5,000,000 during the next two years on an extensive building and new equipment program. The program includes an automatic screw machine building, an engineering building, a $340,000 addition to its present foundry, an addition to the chrome, copper and nickel-plating divisions, an addition to the LaSalle assembly plant, etc.

New Trade Publications

ADVISORY RESEARCH—Finishing Research Laboratories Inc., Chicago, has issued a booklet outlining its service in problems of finishing, by tumbling, dipping, ovens, spraying or other means.

CONVEYORS—Mathews Conveyor Co., Ellwood City, Pa., in a current bulletin suggests the use of gravity with electric power to save labor and increase production, through application of its type of conveyors.

HOISTS, CRANES AND AIR COMPRESSORS—Curtis Pneumatic Machinery Co., St. Louis, in a current bulletin gives data on the performance of its hoists, cranes, trolleys and air compressors in various industries. The booklet contains many illustrations from photographs of typical installations.

BRONZE WELDING—The Linde Air Products Co., New York, recently has published a bulletin on the method used in bronze welding cylinder blocks. The booklet gives full information concerning the preparation of the cylinder for welding and tells how each operation should be done. The folder is well illustrated with views of the work in the process.

STEEL CASTINGS—The current issue of *Research Group News*, the publication of the Electric Steel Founders' Research group, contains some unusually interesting material. An article on fatigue of metals discusses the question in relation to the strength and toughness of ferrous metals, with a description of various methods of testing properties of the metals. Illustrations cover the various machines used in the tests.